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CANADIAN ELECTRONICS ENGINEERING

NOVEMBER 1958
A Maclean-Hunter publication
five dollars a year

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Attila Attacks!

In 452 A.D., the Romans — attempting to stop the fearsome Attila's attack on northern Italy — developed one of the most remarkable military weapons of all time. They called it "nosar" ("sonar" spelled sideways).

"Nosar" was a radar-like device that took advantage of a characteristic peculiar to the Huns: the fact that these hordes of unwashed barbarians gave off an aura so awesome it was capable of paralyzing a small dog at 500 feet. Thus, "nosar" — which could detect and record on its "nostrilloscope" the tell-tale scent of a single Hun at 10,000 yards — seemed the perfect defense weapon.*

Yet, here comes Attila — virtually at the gate of the garrison — and nary a pip shows on the "nostrilloscope"! The horrible Hun has played the dirtiest trick of all — he has ordered his troops to undergo a mass bathing! The garrison is doomed.

The Romans had some consolation, however — Attila and most of his troops fell victims to pneumonia long before they reached Rome. Sometimes, the bath is deadlier than the sword.

No. 7 of a series . . . BOMAC LOOKS AT RADAR THROUGH THE AGES

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November 1958

Volume two, number 11

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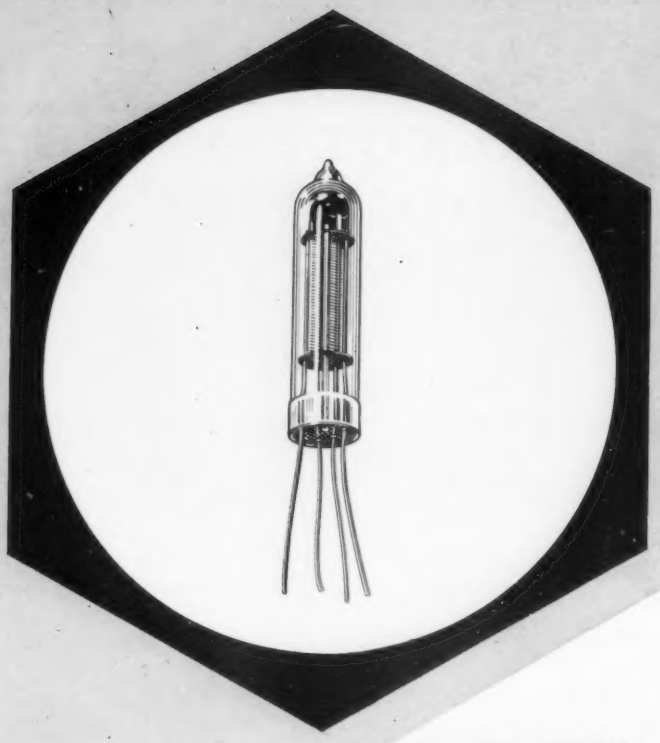
***our cover design** *The IRE Canadian Convention is made up of three major segments—technical sessions, exhibits and informal talks. Our cover is a sampling of these*



The Philips 6977 is a sub-miniature vacuum indicator triode with a fluorescent anode, designed for applications in computers and business machines as an improved replacement for indicator lamps. In transistorized circuits the tube's high impedance and small signal requirements do not load the transistor circuit. Flying leads make it suitable for use with printed wiring. Philips 6977 triode has a life of 20 thousand hours. Overall dimensions are 2.6″ x 0.22″ including leads. Dimensions of fluorescent region are 0.4″ x 0.22″.

Rogers wide range of quality tubes are finding more and more applications in all types of professional equipment. For greater reliability and lower maintenance costs, specify Rogers tubes.

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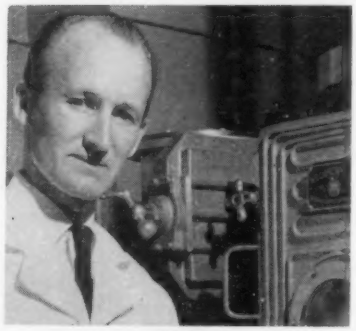

Stavik

Pink

contributors and special articles in this issue:

Mr. Olaf Stavik (Alloyed germanium transistor has symmetrical characteristics) was born in Norway and is a graduate of the University of Oslo, with a B.Sc. degree in physics. He also holds a BSEE degree from the University of Idaho. Between 1955 and 1956 he held the position of assistant instructor at the University of Pennsylvania.

Immediately after that, he came to Canada, and a year later joined Northern Electric Co. Ltd. as a development engineer at the Shearer street plant. In July of this year, Mr. Stavik became a member of the Solid State Physics group of the scientific staff of the company's research and development organization.

G. R. Pink (Anodized aluminum wire is good for 600 degrees C) works hard to make life a little easier for his fellow engineers. The anodizing process developed by his group should be an effective barrier against technician's soldering irons.

Mr. Pink was born in Winnipeg and graduated from the University of Manitoba in Electrical Engineering. He has been with the Aluminum Company of Canada for seven years, starting as a sales engineer in the Toronto sales office. At present he holds the position of electrical conductor development engineer and is stationed in Montreal.

This author works with wire all day long, but in his free time he heads for the woods; his hobbies are woodworking and golf.

Our former Montreal editor, **Anthony Brian** (Amateur TV club plans ambitious program) felt that his capabilities were not being fully taxed — his normal working day was a mere 23½ hours. Consequently, he moved to the Toronto office to become assistant editor of our sister publication, Canadian Packaging. Now he will be able to ply his talents 24½ hours each day.

Our new Montreal editor, **Michael Fallon,** is a recent arrival in Canada, having come here from England in February of this year. He has had several years' experience in journalism, working as a freelancer and with the Express News Services Limited, Bristol.

Michael's chief hobby should be very useful in helping him carry the burden at the Montreal office. He is a weight lifter (not to be confused with lead swinger), and has written several articles and a book on the subject.

The electronics industry has seen some upsetting developments in the past few weeks. Now that the first "shock wave" has passed, **Editor Harold Price** has gathered together the available bits of information. His report should provide the industry with some good "food for thought."

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News highlights...

Canada may take over DEW bases . . .

At a cost of around $4 million a year, Canada may take over four key bases in the DEW line, now operated by U. S. forces — an announcement is expected in the near future. Canada also plans to take over the vast task of supplying all DEW line radar sites in the Canadian Arctic, a $25 million annual operation.

Direct distance dialling extended . . .

Montreal and its suburbs were brought into direct distance dialling range of Toronto area telephone users during September. Montrealers, however, will not be able to dial their calls straight through to Toronto until 1960, when installation of the new equipment is expected to be completed.

Cost of atomic subs to be studied . . .

An Ottawa report states that DDP will soon begin a study of the economic feasibility and cost of building atomic submarines in Canada. The navy is already engaged in a technical study of nuclear propulsion for ships. Recommendations to the government are not expected until early 1960.

Japanese form export association . . .

Manufacturers of electronic equipment in Japan have set up a joint firm in Tokyo to promote sales of their goods abroad. The firm, called the Japan Electronic Equipment Export Association, will conduct market surveys and other activities for the promotion and orderly marketing of exports as well as servicing for goods exported. The association plans to set up an electronics equipment export centre in New York.

DOT prepares Decca Navigator verdict . . .

Evaluation tests into the value to shipping of the Decca Navigator electronic position-fixing system have been carried out for more than a year on Canada's eastern seaboard. The results of the tests are now being studied by officials of the Telecommunications Branch of the Department of Transport and their report will determine governmental decision as to future operation. Tests are also being carried out to determine the applicability of the system to civil aviation.

Transistor tv receivers planned . . .

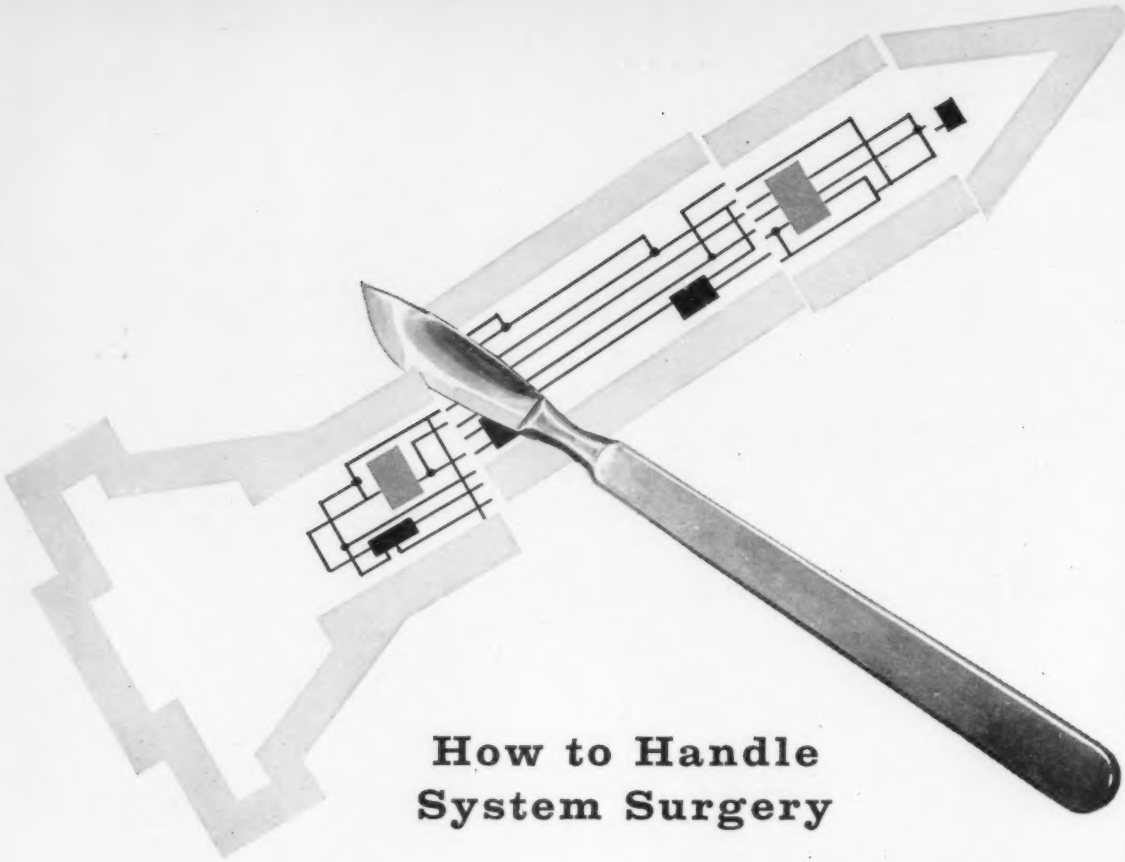
Early use of transistors in low-cost television and radio receivers was recently predicted by W. F. Palmer of Sylvania Electric Products Inc. A current design of auto amplifier using a combination of low-cost tubes and low-cost transistors was claimed to be "comparable in cost and performance" to its all-tube counterpart.

EIA: Components manufacturing grows . . .

The Components Division Trade Directory Committee have met to discuss the 1959 edition of the directory. Growth of this segment of the industry is indicated by recent estimates that during the past five years the number of component manufacturers has increased by about 40 percent, and over fifty additional types of component have gone into production in Canada.

The present annual sales volume of the Canadian electronic components manufacturing industry is believed to be in excess of $50 million.

F. V. Topping Electronics Ltd., 94 Laird Drive, Toronto 17, has been admitted to membership of the Electronics Division.



How to Handle System Surgery

Where to lay the scalpel is rarely the result of engineering considerations alone. Those responsible for the successful operation of the system must consider: (1) the requirements of the system as a whole, and (2) the ability of suppliers to furnish that level of subassemblies or units which fulfill overall system requirements with maximum efficiency.

In the field of servo control systems and assemblies, Daystrom has demonstrated the necessary engineering and production experience to achieve full optimization of subsystems and assemblies—involving the use of servo motors and motor generators, gear trains, synchros, servo amplifiers, servoed indicators, and other servo components. Our work, to date, has included missile guidance assemblies, autopilot sub-systems, radar control systems for aircraft, position display devices for shipboard navigation, air-borne camera control assemblies, flight control assemblies for supersonic aircraft . . . and our experience is growing as fast as the servo field itself.

The specialized help you need to turn modern system requirements into optimized working sub-systems and assemblies is part and parcel of our business. When you need servo motors and motor generators for prototype equipment, Daystrom can meet your requirements—*from stock!* Write us for complete information.

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Muirhead Instruments Ltd., appoint new sales engineer

A. J. Muirhead, vice-president and general manager, Muirhead Instruments Limited, Stratford, Ontario, is pleased to announce the appointment of **R. W. Watler,** AMIEE, as chief sales engineer. Mr. Watler was formerly servo systems engineer with Muirhead's English parent company.

Stewart

Watler

Industrial sales manager

Automatic Electric Sales (Canada) Limited, Toronto, announces the appointment of **Mr. A. C. Stewart** as manager, industrial sales. In this capacity, he will be responsible for directing the sales of Automatic Electric relays and switches, Stromberg time equipment, Paragon time controls and TelAutograph telescribing service to commercial and industrial accounts.

Mr. Stewart is a graduate of the School of Electronics, Ryerson Institute of Technology and, after sales and technical experience with other firms, headed up the Radio Section of Head Office Carrier and Radio Sales for Automatic Electric.

Two promotions at RCA Victor

The appointment of **P. J. Casella,** president, RCA Victor Company Ltd., as executive vice-president, Consumer Products, Radio Corporation of America, was announced by RCA President, John L. Burns.

Mr. Casella will be responsible for the activities of the RCA Victor TV Division, the RCA Victor Radio and "Victrola" Division and the RCA Victor Record Division. In addition to his new duties, Mr. Casella will continue as president of RCA Victor Company, Ltd. in Canada.

Mr. P. J. Casella, president, RCA Victor Company, Ltd. announces that the Board of Directors at its meeting held at the head office in Montreal on October 16 appointed **J. D. Houlding** as vice-president and general manager. Formerly Mr. Houlding was vice-president, Technical Products, including Defence Systems, Tubes and Research Divisions.

Electrical manufacturers elect Turner president

The Canadian Electrical Manufacturers Association has elected **W. I. Turner** as its president for the coming year. Mr. Turner, president of Canadian Controllers Ltd., now heads up one of Canada's largest industries. For the third year the electrical manufacturing industry in Canada has produced more than $1 billion in goods and services. Total domestic production in 1957 was $1.2 billion.

Director of planning for research lab

E. H. Hayes has been appointed director of planning, reporting to A. B. Hunt, general manager of the research and development laboratories of Northern Electric Company Limited.

A graduate of the University of New Brunswick, where he took the degree of B.Sc. Electrical Engineering in 1928, Mr. Hayes joined Northern Electric upon graduation. In September 1944 he was appointed supervisor of transmission equipment standards, becoming assistant superintendent of communications service engineering in 1945 and assistant chief engineer of equipment engineering in 1948, and chief engineer of the communications equipment division in 1952.

Union Carbide announces company changes

The election of **F. Perry Wilson** to the Board of Directors of Union Carbide Canada Limited has been announced by A. A. Cumming, president.

A chemical engineering graduate, Mr. Wilson joined the Bakelite organization in 1941. He assumed the position of vice-president in charge of sales of Bakelite Company, division of Union Carbide Canada Limited in 1953, becoming president the following year. In 1956, he was appointed a vice-president of Union Carbide Canada Limited, the position he holds today.

Mr. Wilson is a member of the Canadian Manufacturers' Association, the Society of Chemical Industry, the Society of the Plastic Industry, Inc., and the Society of Plastic Engineers.

Effective immediately, marketing responsibilities for Thermoplastic products, including Polyethylene and Polystyrene, formerly sold by Bakelite Company, division of Union Carbide Canada Limited, are being transferred to the Carbide Chemicals Company Division.

Bakelite Company will continue to market thermosetting products including Phenolics, Silicones and Epoxy resins.

Personnel formerly concerned with the marketing of thermoplastic products in Bakelite Company are continuing in the same capacity with Carbide Chemicals Company. **A. A. Allan, Jr.,** has been appointed sales manager—plastics for the latter firm, a position he previously held in the Bakelite group. **W. S. Berry** assumes the position of sales manager for Bakelite Company, with responsibility for the marketing of thermosetting plastics. Both will continue to make their headquarters at 40 St. Clair Ave. East in Toronto.

Wilson

Allan

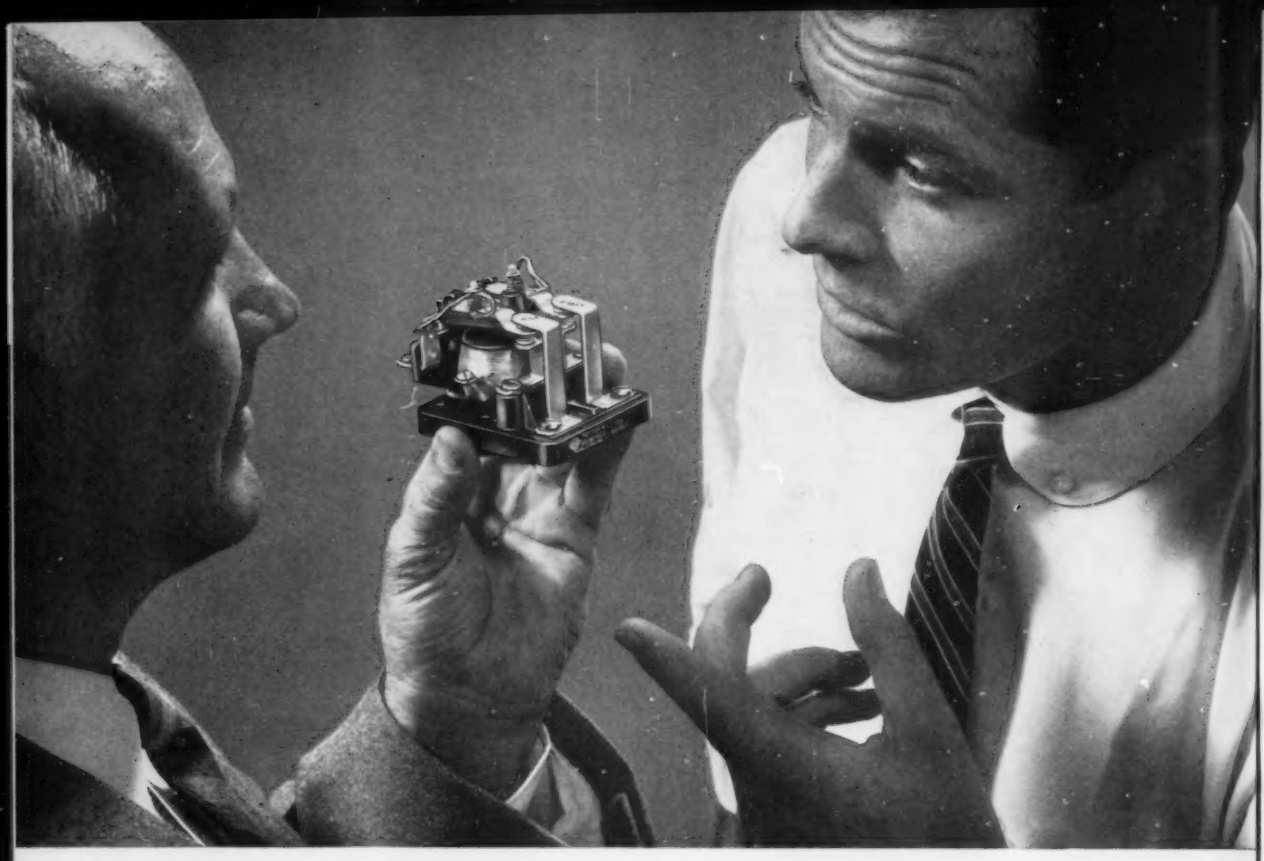
Berry

Hayes

Other company appointments

A. W. Bleue heeded the call of the West and left the head office of R. H. Nichols Ltd. in Toronto to become Nichols' representative in Vancouver. His address is 624 Vancouver Block, 736 Granville St., Vancouver 2, B.C., telephone MUtual 3-0019.

The appointment of **George A. Lewingdon,** formerly Ontario sales manager, as assistant sales manager (Canada) and **John D. Williams** as Ontario sales manager has been announced by T. P. Kelly, sales manager, broadcast and television division, Canadian Marconi Co.



HERE'S WHY P&B's PR POWER RELAY IS PREFERRED

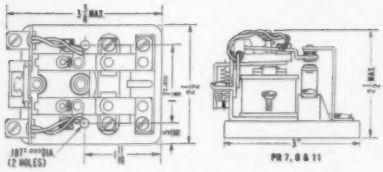
for high current/voltage switching

HEAVY DUTY construction means long-term dependability when switching up to 20 amperes (double break contacts). Here is a ruggedly built relay, packed with high quality features, yet economically priced.

The PR's full floating movable contact carrier, for example, provides excellent contact pressure and ample wipe for self-cleaning contact action. The coil is centrifugally impregnated with top-grade varnish to eliminate moisture traps.

Contact arrangements up to DPDT are available. The PR has been adapted for printed circuitry and heavy duty plug-in applications.

All standard AC actuated PR relays may carry the UL and Canadian Standards Association seals of approval. Write or call for complete information.



GENERAL SPECIFICATIONS:
Breakdown Voltage: 1500 volts rms min. between all elements and ground.
Ambient Temperature: DC: —55° to +85°C.
AC: —55° to +55°C.
Terminals: Heavy duty screw type. Standard printed circuit pins or plug-in on request.
Enclosures: PR dust cover.

CONTACTS:
Arrangements: Up to 2 Form C (DPDT).
Material: 5/16" dia. silver or silver cadmium oxide. (Others available)
Load: Single break: 15 amps; Double break: 20 amps at 115 volts 60 cycle AC resistive.

AUXILIARY CONTACTS:
Arrangements: 1 Form A, B or C.
Material: 3/16" diameter silver
Rating: 5 amps at 115 volts 60 cycle AC resistive.

COILS:
Resistance: 64,000 ohms maximum.
Power: 1.8 watts DC; 9.8 volt-amps AC.
Duty: Continuous AC or DC (DC coils will withstand 10 watts at 25°C).
Insulation: Centrifugally impregnated with high quality varnish.
Mountings: 2 holes .187" diameter 1⅞" o.c.

PR Relays Approved By Underwriters' Laboratories and Canadian Standards Association

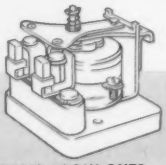
Type	Contact Arrangement*	Type	Contact Arrangement*
PR1AY	SPST-NO	PR5AY	SPDT
PR2AY	SPST-NC	PR7AY	DPST-NO
PR3AY	SPDT-NO-DM	PR8AY	DPST-NC
PR4AY	SPDT-NC-DB	PR11AY	DPDT

These relays are available in any of the following operating voltages: 6, 12, 24, 48, 115, 208, 230, or 440 volts 50/60 cycles AC.

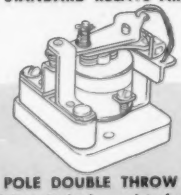
The contacts are rated at: 13 amps, 115 volts AC. 6.5 amps, 230 volts AC. 1 hp for 115 or 230 volt AC motors. Any relays deviating electrically or physically from these standard models will not carry U/L or CSA approval.

*Read: NO normally open, NC normally closed, DB double break, DM double make.

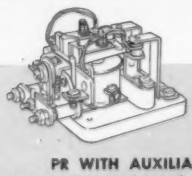
P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



PR RELAY WITH MAGNETIC BLOW-OUTS
Models PR3 and PR7 can be supplied with alnico magnets to suppress arcs on DC loads over 1200 watts.



SINGLE POLE DOUBLE THROW VERSION
PR 5 (SPDT) has all the heavy-duty features of other models in this series.



PR WITH AUXILIARY CONTACTS
All PR models can be equipped with auxilliary contacts in 1 Form A, B, or C arrangements.

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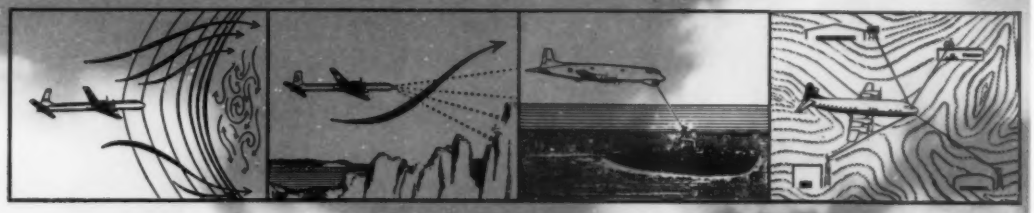
Guelph, Ontario



Electronic vision is needed...

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Multi-purpose airborne radar is just one of the many developments demanded by modern flying conditions. Sperry APN-59 fills four important military needs — storm warning, navigation, search and coded beacon identification. In extensive military service on this Continent, the APN-59 weighing only 175 pounds, is being manufactured at Sperry's Montreal plant for the Royal Canadian Navy.

This is one more example of the versatility of Sperry engineers in the field of electronics.

SPERRY

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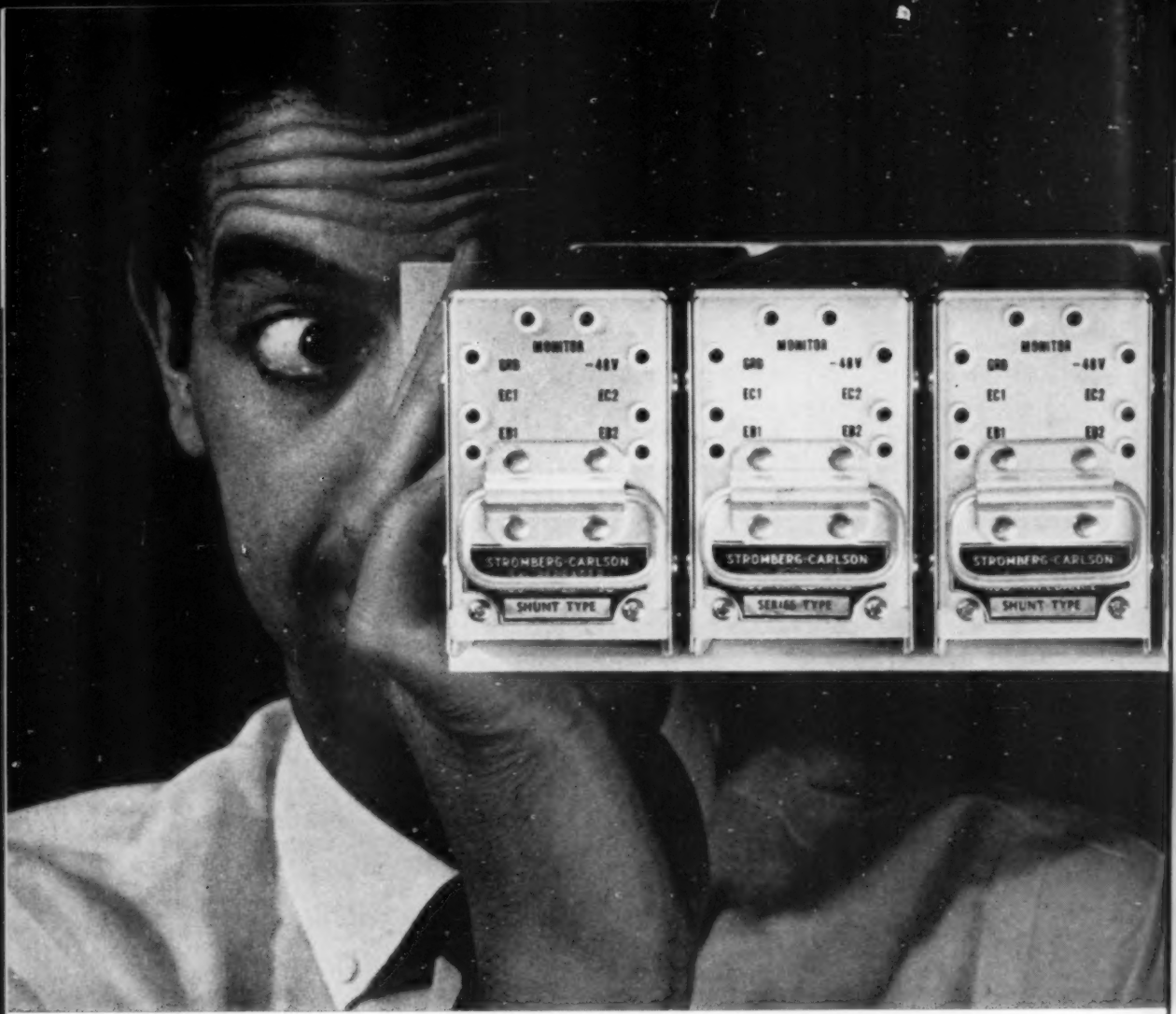

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C.N. Telegraphs commissions new switching system

Two million dollars' worth of Western Union "push-button" telegraph equipment has been put into operation in Montreal by Canadian National Telegraphs.

Known as a reperforator switching system, the new centre will flash an immense volume of messages, not only between Canadian points but to and from all parts of the world. It has a direct-line hook-up with every office in Quebec Province and 120 telegraph offices at major points from Newfoundland to Vancouver. Direct connections also link it with the Western Union network in the United States.

The centre handles messages faster than previously possible in Canada. Messages pouring into Montreal are recorded, at a rate of 60 words a minute, on tape by banks of receiving units, which also print a type-written version of the tape for the operator's use. The operator notes the destination, presses the prescribed button and the message is automatically switched to despatching equipment, at twice the speed at which the message was received in the centre.

All the complicated planning to integrate the centre into the CN communication system was done by the company's traffic experts. The practical capacity of the new equipment is 82,000 messages per day.

Northern Electric opens new head office, research dept.

The head office of the Northern Electric Co. Ltd. is now located in the Northern Building, 1600 Dorchester St. West, Montreal.

The company has also formed a branch laboratory in Belleville, Ont. of its research and development organization, to work on electronics development. Manager of the new laboratory is Robert J. Tanner, Fellow I.R.E.

Automatic Electric establishes Industrial Products Division

Automatic Electric (Canada) Limited, announces the establishment of an Industrial Products Division to manufacture relays, stepping switches and other devices for electrical control applications. A large area of the company's plant at Brockville, Ontario, has been assigned for the purpose.

The products will be distributed in Canada by Automatic Electric Sales (Canada) Limited, Toronto, through their sales offices in principal cities.

RCN to use Canadian Admiral telephone amplifiers

Stuart D. Brownlee, executive vice-president, has announced that Canadian Admiral Corporation, Ltd. has been awarded a contract by the Department of Defence Production for a quantity of telephone amplifiers for use on ships of the Royal Canadian Navy.

The amplifiers are used in conjunction with the sound-powered telephone system in noisy locations where an increase in the signal is required.

Manufactured by Canadian Admiral Electronic Products Division to Navy design, the amplifiers consist of a single transistor stage providing a gain of about 12 decibels and can be switched in or out of the telephone system as required. Two mercury cells which, under normal usage, should last for at least two years, power the new telephone amplifiers.

Company moves

Cossor (Canada) Ltd. have taken over the facilities of the Canadian office of Dawe Instruments Ltd. Mr. S. A. Rybb has joined Cossor as manager of instrument sales, which includes the products currently manufactured and distributed by Cossor and those formerly handled by Dawe. Mr. Rybb is now located at 72 Grenville St., Toronto.

Ampex American Corp. is transferring its instrumentation products operation from Toronto to the Commonwealth Building, 77 Metcalfe St., Ottawa. Barry Simpson, manager, states that this will enable the company to give better service to its major customers.

New service for manufacturers

Product Design and Development, now established at 20A Breadalbane St., Toronto, are offering a complete manufacturers model making service, which will make models, samples or prototypes in any material, quickly and accurately.

Further DDP contracts

Unclassified electronics contracts in excess of $10,000 awarded between Aug. 16 and Sept. 16 were as follows: Ahearn & Soper Co. Ltd., equipment, $86,828; Atomic Energy of Canada Ltd., equipment, $22,361; Bayly Engineering Ltd., communication equipment, $11,895; Canadian Applied Research Ltd., aircraft navigation equipment, $1,086,400 and $255,800; Canadian Aviation Electronics Ltd., technical services, $37,419 (total of 3 contracts); Canadian General Electric Co. Ltd., radar spares, $11,875, and tubes, $17,932 and $106,848; Canadian Marconi Co., development, $37,589, and tubes $136,290; Canadian Westinghouse Co. Ltd., tubes $348,738 and $83,833.

Collins Radio Co. of Canada Ltd., equipment, $35,200, development, $24,944, and repair and overhaul, $85,000; Northern Electric Co. Ltd., teletype spares, $49,972; RCA Victor Co. Ltd., tubes, $67,625 and technical services, $16,495; Rogers Electronic Tubes & Components, tubes, $22,777; Servomechanisms (Canada) Ltd., repair and overhaul, $45,000; Sperry Gyroscope Co. of Canada Ltd., aircraft navigation equipment, $17,974; Stewart-Warner Corp. of Canada Ltd., radar spares, $19,996; TMC (Canada) Ltd., equipment, $132,870.

James Key of Aerovox Canada Ltd., EIA vice-president and chairman of the components division, announces another lucky draw prize winner. Occasion was the recent EIA-IRE Golf Tournament at Scarborough, Ont. Low gross trophy winners were B. Bennett of Fleck Electrical Mfg. and M. Bellis of Sparton of Canada, N.B.

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GROUP I—RECEIVING TUBES

HY-G-200®

EIA Type No.	JAN Type No.	PROTO-TYPE	BENDIX Type No.	DESCRIPTION
5838		6X5	TE-3	RECTIFIER. Full-wave
5839	5839	6X5	TE-2	RECTIFIER. Full-wave
5852	5852	6X5	TE-5	RECTIFIER. Full-wave
5992	5992	6V6	TE-8	AMPLIFIER. Beam power
5993	5993	6X4	TE-10	RECTIFIER
6106	6106	5Y3	TE-22	RECTIFIER
6385		2C51/ 5670	TE-21	MINIATURE TWIN TRIODE
6486		6AS6	TE-11	MINIATURE PENTODE
6582		6AK5	TE-35	MINIATURE PENTODE

HY-G-300®

(Reliable, hard glass, ceramic spacers, 300°C Bulb Temperature Rating)

6080WB		6AS7	TE-46	TWIN TRIODE
6082A		6082	TE-55	TWIN TRIODE
6094	6094	6AQ5/ 6005/ 6095	TE-18	MINIATURE AMPLIFIER
6384	6384	6AR6/ 6098	TE-27	AMPLIFIER Beam power
6486A		6AS6	TE-43	MINIATURE RF PENTODE
6582A		6AK5	TE-44	MINIATURE RF PENTODE
6754		412A	TE-36	RECTIFIER. Full-wave
6851		5751	TE-42	MINIATURE TWIN TRIODE
6853		5Y3	TE-45	BANTAM RECTIFIER. Full-wave
6854		2C51/ 5670	TE-47	MINIATURE TWIN TRIODE
6877		½ 6080	TE-48	MINIATURE TRIODE
6889		Top Cap 6384	TE-52	AMPLIFIER. Beam power
6900		5687	TE-54	MINIATURE TWIN TRIODE

COMPUTER TUBES

6888		7AK7	TE-40	GATED PENTODE

GROUP II—MICROWAVE TUBES

EIA Type No.	JAN Type No.	BAND	BENDIX Type No.	DESCRIPTION
2K50	2K50	K	TE-4	REFLEX KLYSTRON
6116	6116	X	TE-62	REFLEX KLYSTRON
6541		K	TE-30	REFLEX KLYSTRON
6584		C	TE-38	REFLEX KLYSTRON
		Ka	TE-37	REFLEX KLYSTRON
		Ka	TE-53	REFLEX KLYSTRON
6845	6845 (US Navy)	X	TE-59	REFLEX KLYSTRON
6940		X	TE-58	REFLEX KLYSTRON
		K	TE-60	REFLEX KLYSTRON
		X	TE-61	REFLEX KLYSTRON
		V	TE-67	BACKWARD-WAVE OSCILLATOR
		C	RXB-103401	TRAVELLING-WAVE TUBE AMPLIFIER
		V	TE-66	BACKWARD-WAVE OSCILLATOR

GROUP III—GAS AND SPECIAL TUBES

SPECIAL PURPOSE GAS TUBES

EIA Type No.	JAN Type No.	BENDIX Type No.	DESCRIPTION
5643	5643	TD-17	SUBMINIATURE XENON THYRATRON (MIL SPEC)
5643		TD-37	SUBMINIATURE XENON THYRATRON (COMMERCIAL SPEC)
5947		TT-2	TEMPERATURE LIMITED DIODE
5960		TD-1	COLD CATHODE DISCHARGE
		TD-45	COLD CATHODE DISCHARGE
		TD-28	COLD CATHODE TETRODE THYRATRON
6142		TD-9A	GAS DIODE VOLTAGE REGULATOR
		TD-19	GAS DIODE VOLTAGE REGULATOR
6144		TT-1	NOISE DIODE
6352		TT-29	SUBMINIATURE TEMP LIMITED DUAL-DIODE
6361		TT-25	SINGLE CONVECTRON
5845		TT-30	MINIATURE TEMPERATURE-LIMITED DIODE

GROUP IV—GAS NOISE SOURCE TUBES

Frequency Range KMC	Band	Waveguide Number	Bendix Type Number	EIA Type Number	Mount Type	Recommended Mode of Operation	Anode Current MA	Tube Drop Volts	Tube Excess Noise Ratio DB
1.12-1.70	L	RG-69/U	TD-21	6881	90°H	D.C.	250	65	15.2
			TD-29	7101	90°H	A.C. & D.C.	250	130	18.0
2.6-3.95	S	RG-48/U	TD-12	6358	10°E	D.C.	250	80	15.2
			TD-22	6782	90°H	A.C. & D.C.	250	45	15.2
3.30-4.90	S	WR-229	TD-24	6852	10°E	A.C. & D.C.	250	65	15.2
3.95-5.85	C	RG-49/U	TD-10	6356	10°E	D.C.	250	70	15.2
5.85-8.20	X	RG-50/U	TD-10	6356	10°E	D.C.	250	70	15.2
8.20-12.40	X	RG-52/U	TD-11	6357	10°E	D.C.	200	75	15.2
			TD-23	6882	10°E	D.C.	200	115	18.0
12.4-18.00	KU	RG-91/U	TD-18	6684	10°E	D.C.	200	70	15.2
18.0-26.5	K	RG-53/U	TD-13	6359	10°E	D.C.	200	65	15.2

GROUP V—SPARK GAPS

Type No.	DC Break-down KV	Initial Pulse Break-down KV	Repetitive Pulse Break-down KV	Watts Maximum Dissipation	Peak Discharge Watt-Second	Fault Surge Current Amps	Isotope Stabilization	Initial Equipment Usage	Configuration
TG-25	0.400			3	2		Yes	Safety	1
TG-26	0.75			5	2	1000	Yes	Safety	2
TG-27	1.0			5	5	1000	Yes	Safety	2
TG-30	2.0	3.0	2.7	5	14	2000	Yes	Safety	2
TG-34	5.0	8.5	5.5	5	19	3000	Yes	Safety	2
TG-37	10.0	20.0	15.0	5	22	4000	Yes	Safety	2
TG-56	20.0	23.0		7.5	30	5000	Yes	Safety	4
TG-60	50.0			7.5	50	6000	Yes	Safety	4

Many other models of Bendix gas noise source and spark gap tubes besides those shown here are available. There is also a HY-G-500 line of metal ceramic receiving tubes. For a completely up-to-date list, write

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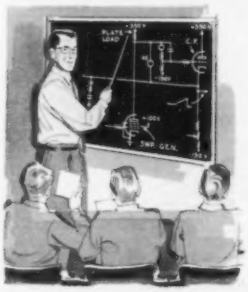
The Manufacturer's Responsibility to the User

YOUR REQUIREMENTS for increasingly higher performance in oscilloscopes inevitably lead to instruments of greater complexity, and therefore to an enlarged responsibility on the part of the instrument manufacturer to provide needed assistance in the field. As a user of Tektronix Instruments you have easy access to a large well-trained field organization, anxious to help with any problems that arise due to unfamiliarity with new circuits or other factors. All services described below are readily available through twenty-four Tektronix Field Offices in North America. Most of these services are also provided by more than twenty Tektronix Engineering Representatives in pertinent overseas locations.



Maintenance—Tektronix willingly assumes much of the responsibility for continued efficient operation of the instruments it manufactures. If you should experience a stubborn maintenance problem, your Field Engineer will gladly help you isolate the cause. Often a telephone discussion with him will help you get your instrument back into operation with minimum delay. If yours is a large laboratory, your Field Engineer can be of service to your maintenance engineers by conducting informal classes on test and calibration procedures, trouble-shooting techniques, and general maintenance.

If you are responsible for the maintenance of a large quanity of Tektronix Instruments, ask your Field Engineer about the free factory training course in maintenance and calibration.

Applications—Perhaps the answers you need in a specific application can be obtained faster and easier through use of your Tektronix Oscilloscope. Your Field Engineer can help you find out, and if use of your oscilloscope is indicated, help you with procedures. He may also be able to suggest many time-saving uses for your oscilloscope in routine checks and measurements.

Ordering—There are many types of oscilloscopes, each designed for a specific application area. Your Field Engineer can help you select the one best suited to your present and future needs, and he will be happy to arrange a demonstration of the instrument . . . in your application if you so desire.

If you are a Purchasing Agent or Buyer, your Field Engineer or his secretary can help you with information on prices, terms, shipping estimates, and best method of transportation on instruments, accessories, and replacement parts.

Operation—Your Tektronix Oscilloscope can be most useful to you when you are familiar with all control functions. Your Field Engineer will be glad to demonstrate the use of your instrument in various applications to help you become more familiar with its operation. If your instrument is to be used by several engineers, your Field Engineer will be happy to conduct informal classes on its operation in your laboratory.

Communications—Your Field Engineer is a valuable communication link between you and the factory. He knows the exact person to contact in each circumstance, and he can reach that person fast and easily. Let him help speed your communications with the factory on any problem related to your Tektronix Instruments.

Instrument Reconditioning—An older Tektronix Oscilloscope, properly reconditioned, can give you many additional years of service. Your Field Engineer will gladly explain the advantages and limitations of factory reconditioning, and make the necessary arrangements if you decide in favor of it.

Many major repair and recalibration jobs can be performed at a nearby Field Repair Station. Ask your Field Engineer about this at-cost service to Tektronix customers.

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Tektronix is represented in 20 overseas countries by qualified engineering organizations.

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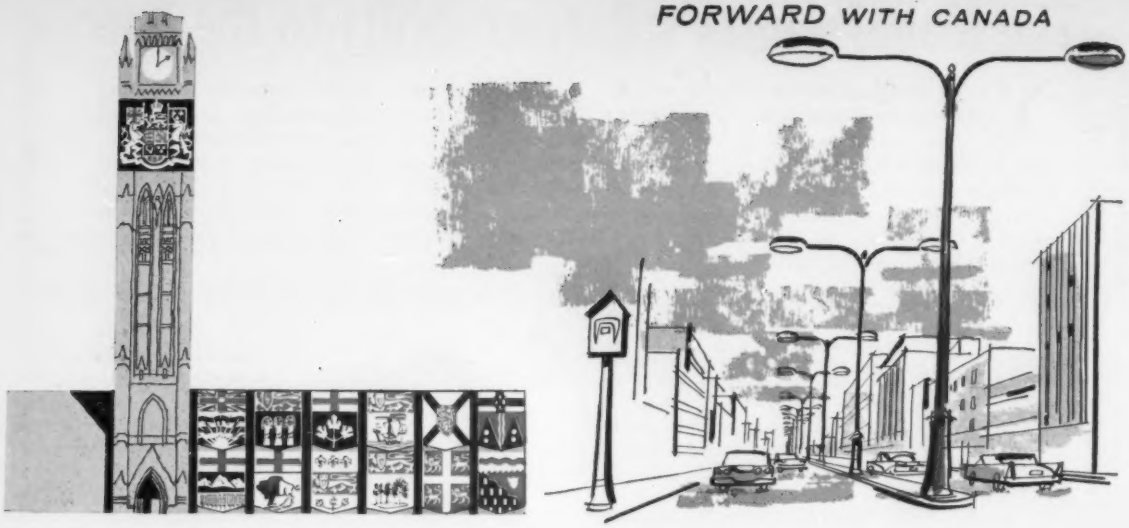
FORWARD WITH CANADA



Blueprinting The Future...

"You'll find them at the intersection of 'Eleventh and Elm' in any of a thousand little towns . . . or strung across the concrete canyons of a hundred hustling cities.

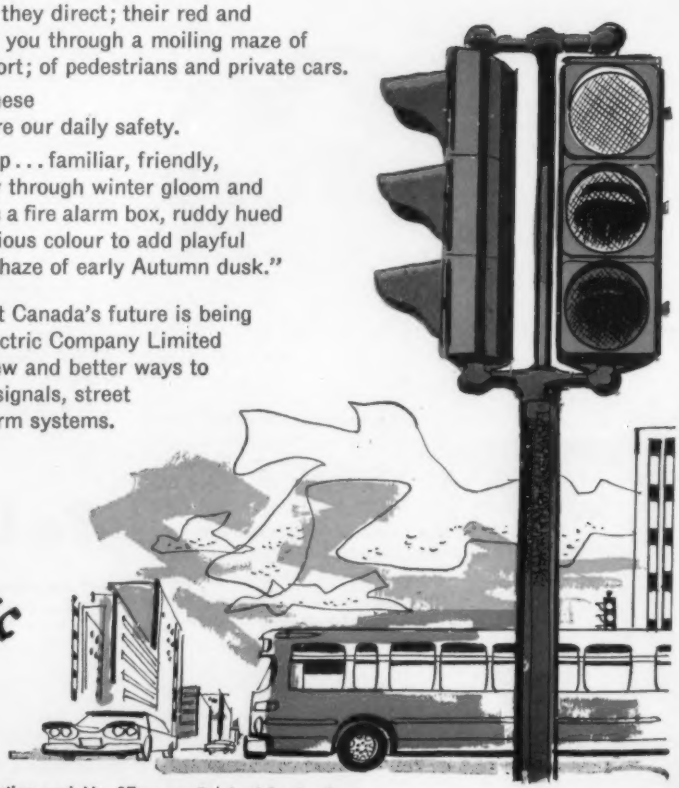
You'll find them sharing the sedate seclusion of a small suburban sidestreet . . . or standing, shadowed by a towering tenement, a movie theatre, a school, a hardware store . . .

You'll stop—or go—or wait, as they direct; their red and green and amber eyes gentling you through a moiling maze of taxis, trucks, and public transport; of pedestrians and private cars.

Their shapes may vary, too—these automated sentries which secure our daily safety.

You'll see them as a street lamp . . . familiar, friendly, comforting . . . guiding your way through winter gloom and fragrant summer night . . . or as a fire alarm box, ruddy hued and cheerful . . . a patch of precious colour to add playful contrast to the graying, wistful haze of early Autumn dusk."

In keeping with their belief that Canada's future is being shaped today, the Northern Electric Company Limited is continuously searching for new and better ways to bring you more efficient traffic signals, street lighting equipment, and fire alarm systems.



Northern Electric
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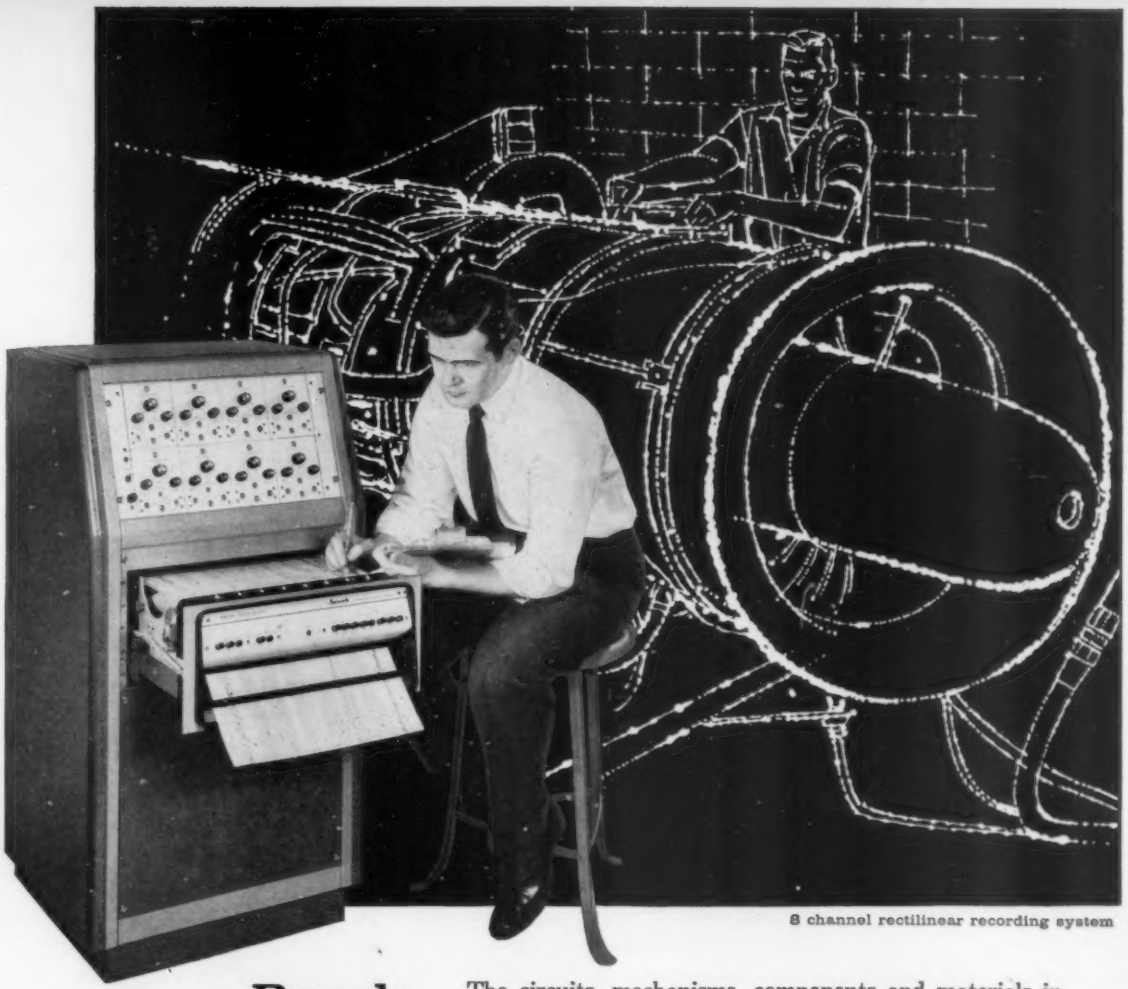

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Brush ultralinear recording systems

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The circuits, mechanisms, components and materials in this 8-channel recording system have *already proved their reliability* in Brush instrumentation now in use in the most critical applications—such as radar surveillance, computer readout, missile checkout on remote test ranges . . . in extremes of temperature, humidity and other abnormal conditions. At Brush, the high reliability factor is always a basic consideration in design.

In the system shown here, trace presentation is rectilinear. Thermal writing provides clear, sharp traces, excellent for reproduction. Eight chart speeds, stepped from .4 to 100 mm/sec., operate by pushbutton controls. The system readily adapts to pertinent MIL specs.

With their wide measurement ranges, Brush *Ultralinear* Recording Systems may be used for development and checkout of industrial as well as military equipment. Factory branches, service and warehousing at Arlington, Va., Boston, Cleveland, Los Angeles, San Francisco and Seattle; engineering representatives in all key locations.

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Model 2610

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The vertical deflection system has a sensitivity in excess of 3.3 millivolts r.m.s./cm. and offers a choice of A.C. or D.C. coupling with either a linear response to 6 Mc/s or a suitable roll-off for transient observations; in the latter condition the rise-time is 80 millimicroseconds with overshoot less than 3%. For pulse observation a 0.3 microsecond signal delay can be switched in. Marker signals can be applied via a differential input terminal.

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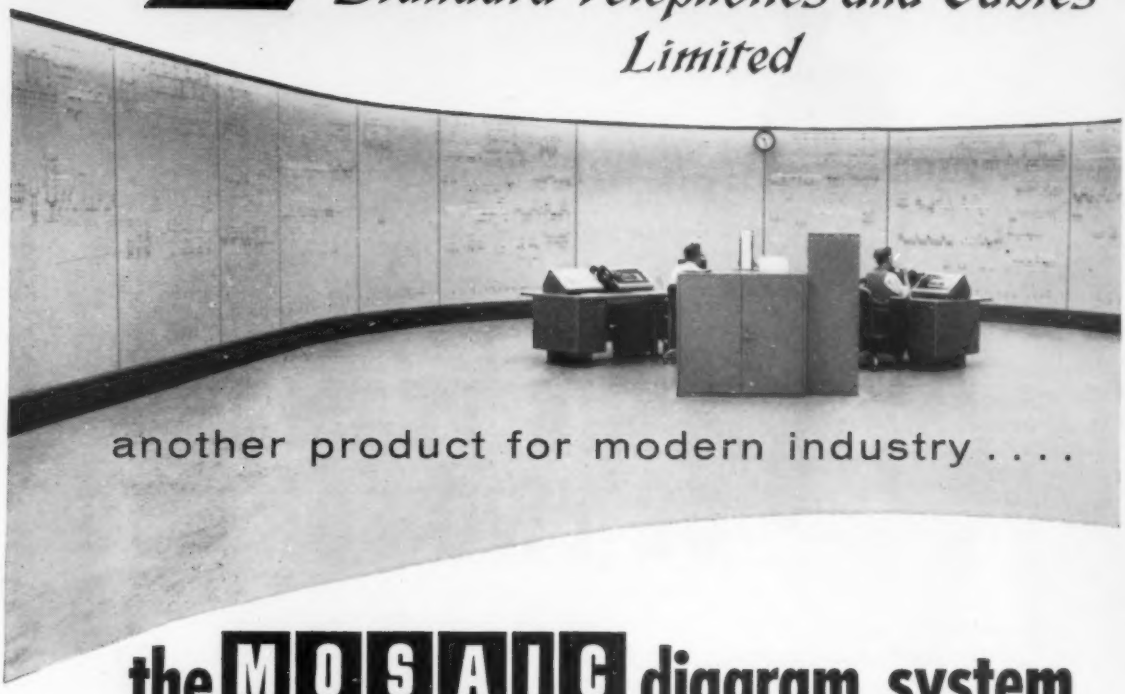
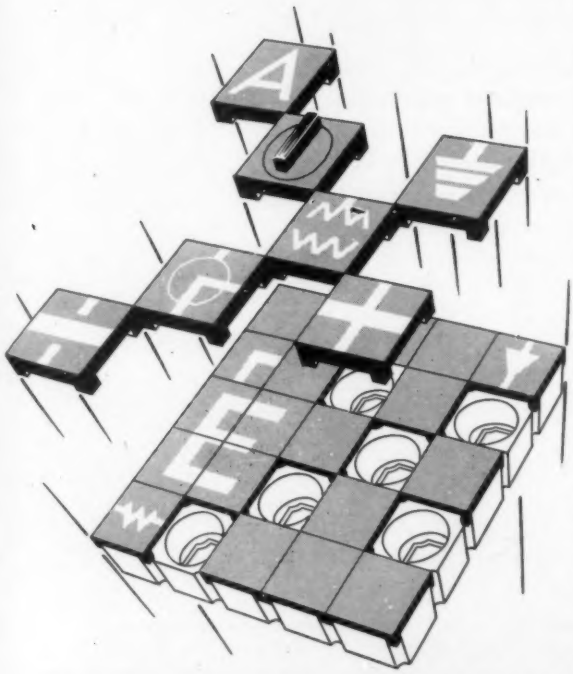


the MOSAIC diagram system



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Lenkurt and Automatic Electric, working as a team, design, engineer and install all types of radio and telephone communications equipment—to *exact* specifications. Their combined experience and skills are built into every piece of equipment. Each installation is backed by an unmatched repair and replacement service.

Find out how Lenkurt and Automatic Electric, working together, can help solve *your* communications problem.

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5832

AUTOMATIC ELECTRIC

ORIGINATOR'S OF THE DIAL TELEPHONE

GENERAL SYSTEM

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Fast action vital to industry's future

Canada's electronics industry was surprised by the sudden government decision of September 23 to cancel the Astra and Sparrow programs, and many people in it were also shocked at the possible consequences. An outline of events since the announcement is given on the next two pages.

Commenting on the announcements, Mr. Diefenbaker said: "It now seems evident that in the larger weapon systems now required for air forces, Canadian work in the design, development and production of defense equipment will have to be closely integrated with the major programs of the United States. The U. S. government recognizes this and they are now prepared to work out production sharing arrangements with us. To accomplish effective integration of defense production resources of Canada and the United States will require time and continuing efforts in co-operation."

We are sure that the industry is well aware that the road to full interdependence in defense electronics will be long and hard. We are also sure that it fully appreciates the prompt steps taken by DND and DDP in arranging for discussions with U. S. officials and accelerating the formalities involved in giving the industry "stop-gap" support.

But is the full seriousness of the immediate situation realized? Potential U. S. employers of our engineers and scientists have already been taking advantage of the insecurity which many professional personnel must be feeling. The danger is that of a mass migration of top development teams to the United States unless something is done to tide the industry over the next several months, the least period in which new contracts can be initiated as a result of the negotiations now getting under way. This period could be lengthened considerably, depending on the success of the aviation, missile and electronics industries' lobbies in Washington, which are all exerting extreme pressures on the U. S. administration.

EIA has pointed out to the government that the normal growth of consumer and industrial markets requires in addition continued participation in major defense programs. These enable us to keep abreast of rapidly advancing technological progress and to retain the scientific and engineering personnel and facilities on which the industry depends for the development of new commercial products for domestic and foreign markets.

If the avowed U. S. policy of interdependence between the nations of the western hemisphere can be taken at its face value, we presume that they recognize the immense value of a northern neighbor which can fulfill higher functions than "hewing wood and drawing water." But very rapid steps must be taken by the Canadian government to make the United States realize the grave danger of our falling into this position.

We have design and development teams in our industry which have worked together for longer periods than many of their equivalents in the U. S. There are many areas in which they can do a job better, more quickly and at less cost. Give them the work now and the future of the industry and Canada's role as an ally — not a mere satellite — will be assured.

THE EDITOR

The Avro CF-105 Arrow supersonic interceptor aircraft — production decision postponed until March, 1959

Canadian electronics industry hit hard

". . . as a further consequence of the reasons given above, the government has decided that it would be clearly unwise to proceed with the development of a special flight and fire control system for the CF-105 aircraft known as the ASTRA and of a special air-to-air missile to be used as its armament known as the SPARROW. The contracts for the development of the Astra fire control system and of the Sparrow missile are now being terminated.

"In the meantime, modifications of the CF-105 will be made during its development to permit the use of a fire control system and weapon already in production for use in U. S. aircraft engaged in North American defense. The important savings achieved by cancelling the Astra and Sparrow programs and substituting these alternatives now in production would amount to roughly $330 million for a completed program of 100 aircraft.

"The total cost to the Canadian government of developing the Arrow aircraft and its associated elements up to the beginning of September has been $303 million. To finish this development of the CF-105 and its components, including Astra and Sparrow, and to produce enough to have about 100 aircraft for squadron use would cost about another billion and a quarter dollars—approximately 12½ million per usable aircraft. By substituting the alternative fire control system and missile for the Astra and Sparrow the cost could be reduced to about $9 million each."

These are the terms in which the Prime Minister announced on September 23 the decision which has had profound effects on a large segment of the Canadian electronics industry.

The reasons referred to in this part of the announcement were related to the introduction of ground-to-air missiles into the Canadian air defense system and the reduction in the expected need for manned, supersonic, interceptor aircraft.

Arrow decision postponed

Much has been written in recent weeks on the pros and cons of the basic decision not to put the CF-105 Arrow aircraft into production at this time. On October 27, Mr. Crawford Gordon, president of A. V. Roe Canada Ltd., presented at his company's annual meeting three reasons for confidence in a favorable government decision next March on the future of the Arrow and its Iroquois engine. He also put the present cost per aircraft, on a basis of an order for 100, at $3½ million, excluding only missile armament.

Our purpose here, however, is not to discuss the validity of the basic government decisions. We may be sure that these decisions were not made lightly. They have been forced upon the government by revolutionary changes in military science and by the ever-increasing difficulty and expense of producing the weapons which grow constantly more complicated. The immediate task is to examine the effects of these decisions on the Canadian electronics industry now, in the near future, and over the long haul ahead.

Many companies affected

The companies directly affected by the termination of the Astra and Sparrow contracts are spread from Montreal through to Hamilton, Ontario.

RCA Victor Co. Ltd., Montreal, had established a large group in its defense systems division to handle production of the fire and flight control system, developed by the parent company in the U. S. The suddenness of the cancellation left the company little choice but to lay off the majority of those employed in the division, including professional engineers and supervisory personnel, and leaving only a relatively small nucleus.

The main contractor on the Sparrow program was Canadair Ltd., also in Montreal. Allan B. Oxley, IRE regional director and reliability co-ordinator, special weapons at Canadair, said during the IRE Convention in Toronto that the cancellation would mean the loss of some 475 specialists unless some other defense contract was forthcoming. Sub-contractors located in Montreal include Aviation Electric Ltd. and the Sperry Gyroscope Co. of Canada Ltd.

Associate contractor on the radar seeking system for Sparrow was the electronics division of Canadian Westinghouse Co. Ltd. in Hamilton. The De Havilland Aircraft of Canada Ltd. in Toronto was also involved in the missile's electronic equipment.

Other sub-contractors involved in these programs are believed to include Computing Devices of Canada Ltd.,

- **Astra and Sparrow cancelled**
- **Engineers and scientists laid off**
- **Others lured by U.S. firms**
- **Some government assistance given**
- **Talks held in Ottawa**
- **Industry must help itself**

by CF-105 decision

The Boeing IM-99 Bomarc interceptor missile—to be procured for the RCAF

Ottawa; Honeywell Controls Ltd., Toronto; Varian Associates of Canada Ltd., Georgetown, Ont.; and many others.

A number of these companies have been able to keep layoffs to a minimum. In some cases only technicians, draughtsmen and clerical help were affected, the professional engineering staff coming through unscathed—so far.

Meanwhile, Ottawa had not been slow to move in the face of the new situation. Following closely on Mr. Diefenbaker's announcement, Mr. D. A. Golden, Deputy Minister of Defense Production, was in Washington preparing for talks between Canadian and U. S. officials.

Top level meetings

A full day's conference was held in Ottawa on October 10, under Mr. Golden's chairmanship. The most immediate topic was the general problems associated with providing Canada with the Bomarc ground-to-air missile, the strengthening of the Pinetree radar control system and the installation in Canada of the SAGE electronic control and computing system.

However, the presence of assistant secretaries from each of the three services in the group of about twenty U. S. officials and service officers was regarded as an indication that a policy decision had already been made by the U. S. administration at least to explore in depth the possibility of much closer production integration.

Share in major programs

It is understood that Canadian emphasis was on the desirability of obtaining a share in programs requiring expert scientists and engineers, skilled technicians and modern factory equipment. Not only will these production potentials be of value in supplying maintenance skills and facilities for the additional equipment to be procured by Canada, but they can play a key part in the design and production of the new weapon systems which will become vital to our joint continental defense plans.

It has been stressed that immediate results cannot be expected from the long series of top-level conferences and working party meetings which will be needed to work out fully a broad program of integration.

Official recognition of the immediate problems facing the industry is understood to have taken the form of awarding study type contracts to the more seriously affected companies. However, it is obvious that this kind of measure can at best only assist some companies to retain a small nucleus of their most highly skilled personnel.

It is also hoped that firms will be able to assign scientists and engineers to other types of work within their own organizations. In addition, government encouragement is being given to the industry to go out and "sell itself" to U. S. military electronic procurement agencies, either directly or with the help of American parent or affiliate companies.

Recruiting teams here

Several U. S. electronics firms took advantage of the coincidence of the cancellations and the IRE Convention to send recruiting teams to Canadian cities early in October. There is no doubt that they will have had considerable success, particularly where layoffs have occurred, but the full picture will not be apparent for weeks to come.

A meeting between the Minister of Defense Production and the Government Liaison Committee of the Electronic Industries Association of Canada was scheduled for October 29. No report was available at press time, but it is understood that the main points to be tabled by the committee concerned the immediate problem of retaining intact the research and development teams that have been built up by the Canadian electronics industry, and the creation of a better climate for the continuation of R and D on a long-term basis. END

Fig. 1. The Muirhead Instruments Ltd. frequency bridge model D-101-C has two ranges: 100-1,210 and 1,000-12,100 cps

Frequency bridge uses modified Wien circuit

J. A. B. DAVIDSON, M.A.*

This frequency bridge, manufactured in Canada by Muirhead Instruments Limited is based on the well-known circuit originated by Max Wien in 1891. It has two ranges, 100-1,210 cps and 1,000-12,100 cps determined by selection of capacitors. Within each range the tuning is continuously variable using normal 2-decade conductance units shunted by a fixed resistance in series with a variable resistance

It is safe to say that a greater variety of uses has been found for the Wien bridge circuit than for any other circuit. A very good account of those relating to pure bridge measurements is to be found in B. Hague's "A.C. Bridge Methods," 5th edition, pp 344-351. The circuit also has found widespread use in the most important class of rc oscillators, and more recently, in selective amplifiers and wave analyzers.

The basic Wien bridge circuit used in the frequency bridge type D-101-C is shown in Fig. 2. The balance equations are:—

$$\frac{R_1}{R_2} = m + n, \text{ and } \omega_0 = \frac{1}{\sqrt{mnRC}}$$

The bridge employs values of m and n of 1, so that

$$\omega_0 = 1/RC, \text{ and } R_1/R_2 = 2$$

As $\omega \propto 1/R$ or $1/C$ a decade control of frequency can be obtained by varying $1/R$ in equal amounts i.e. by the use of equal conductance steps.

Normally the input voltage is e_0 in Fig. 2 and the detector is connected across the other diagonal.

In certain applications it may be desirable to calculate the off-balance bridge output. In these circumstances it is preferable to transpose source and detector since the mathematical expression for the out-of-balance voltage is then simplified. With this conjugate connection e_1 in Fig. 2 is the input and e_0 is the output.

Then, for the general case shown:—

$$\frac{e_0}{e_1} = \frac{1 + n + m - j\sqrt{mn}\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)}{(1 + n + m)^2 + mn\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)^2} - \frac{R_2}{R_1 + R_2}$$

*Muirhead & Company, Limited.

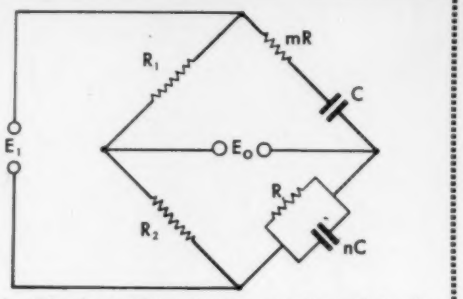


Fig. 2. The basic Wien bridge circuit used in the Muirhead Instruments Ltd. frequency bridge D-101-C

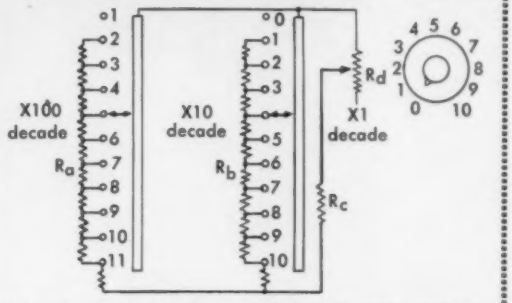


Fig. 3. One of the variable resistance sections from the Muirhead Instruments frequency bridge

This expression is valid only if a high impedance detector is used, and in the D-101-C bridge where $m = n = 1$ it reduces to

$$\frac{e_0}{e_1} = \frac{3 - j\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)}{9 + \left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)^2} - \frac{1}{3}$$

The first use of the Wien bridge circuit for measuring frequency appears to be due to Robinson[1] who used 4-dial ganged conductance units for the R arms. The D-101-C bridge is based on this, but in addition use is made of an artifice used by Campbell in his precision capacitance bridge[2], and described below.

The decade principle

Fig. 3 shows one of the variable resistance sections, the other one being identical and ganged with it. Each consists of a normal 2-decade conductance unit R_A R_B shunted by a fixed resistance R_C in series with a variable R_D. When R_A and R_B are both open circuited and R_D is at maximum the capacitor and resistor values are such that ($R_C + R_D$ max.) corresponds to a frequency of 100 cps. When R_D is reduced to zero the balance frequency alters to 110 cps. Thus varying R_D from maximum to zero has the same effect as one step of the x10 decade irrespective of the positions at which the x100 and x10 decades may be set. The result is a 3-dial decade system in which the last dial is continuously variable. It thus not only takes the place of the normal 3rd and 4th dial, but also improves the setting accuracy considerably. We cannot, of course, get something for nothing, and the price paid in this case is limitation of range. With a normal 3-dial decade system the range is 111 to 1, but in the system described above it is limited to 11.1 to 1 by the fixed resistor R_C. This is not a serious disadvantage since the capacitors can easily be switched to give the necessary multiplying factors.

The frequency bridge

The bridge has two ranges, 100-1,210 cps and 1,000-12,100 cps, the tuning capacitors being switched to provide the two ranges. The bridge is grounded on one side of the supply terminals and the detector is connected via a balanced and screened transformer. A small potentiometer at the junction of the ratio arms enables exact balances to be made throughout the frequency range. The accuracy of the bridge is stated to be ± 1 cps or ± 0.25%, the ± 1 cps figure being necessary because, when using headphones as a detector, it is difficult at low frequencies to determine the exact balance. With an aperiodic amplifier-detector, particularly if it has a non-linear characteristic, intermodulation of the harmonics may cause a false balance to the extent of ± 1 cps, but if a selective detector is available the figure of ± 0.25% can be achieved over the entire frequency range. The stability is extremely good and is several times better than the accuracy figure.

The bridge is most easily used over the telephonic frequency range since here headphones can be used as the detector. Using headphones only it is possible to balance the bridge to an accuracy of 0.25% at 800 cps with an input of 1 volt. The bridge input impedance varies from 400 ohms to 1500 ohms over its frequency range.

Applications

The instrument is surprisingly versatile, and there are many odd problems which may be solved with its aid. It is of value in keeping a check on the frequency of laboratory oscillators since its stability is of a definitely higher order than the majority of such oscillators. In conjunction with some form of selective detector it can be used as a harmonic analyzer, and in this connection it is important to note that its off-balance output can be accurately calculated since it does not depend on Q values as does that of the L-C frequency bridge. It can also be used very simply to record the fluctuations of mains frequency by tuning to a suitable harmonic and recording the out-of-balance voltage which for small differences is proportional to the difference between the balance frequency and the frequency being measured. END

References:

1. *Robinson, C. "A direct-reading frequency meter for telephonic currents," Journal P.O.E.E. 16 (1924), pp 171-174.*

2. *Hague, B. Campbell's precision condenser bridges. A.C. bridge methods, 462.*

Each transistor assembly, complete with glass foot and connecting wires is pre-tested for electrical characteristics. Test is performed in sealed dry-box containing nitrogen atmosphere. Cleanliness is of utmost importance here.

New plant for semiconductor production

British firm will have all operations under one roof

LEO WALTER*

Production of semi-conductors, particularly transistors requires not only great experience in the choice of raw materials but also special manufacturing facilities. A new manufacturing centre for transistors has reached its first stage at Southampton in England. The plant has been built by the Mullard Radio Valve Co. for mass production of semi-conductors on a scientific basis. The long-term project embraces research, development and application laboratories, and has its own tooling department.

At the present time only about one third of this new plant has been completed, and this section will be in production soon. More sections will come into operation whilst building is proceeding. A special form of building construction is used to enable progressive occupation. Employment will be ultimately given to about 2,000 people.

The production program is based on an estimated output of several million semi-conductor devices of all kinds during 1958, of which a considerable portion will be transistors.

As is well-known one of the main requirements for manufacture of transistors is utmost purity of semi-conductor materials. A continuous check is therefore essential. For example, a large quartz spectrograph is used in the spectrograph laboratory to detect small traces of impurities in materials. A powerful electron microscope in the Electron Microscope Laboratory can determine minute particles, smaller than 1 thousandth of a millimeter in diameter. This instrument is used, amongst other things, to examine the surfaces of single crystals of semi-conductor material.

Amongst the many precision engineering operations, the following require great skill and experience. A very critical soldering operation has to be performed for connecting wires to the emitter and collector of the transistor. The aid of an optical magnifier is required and a stream of hot gas is used to effect the soldering. Immediate inspection follows in the flow line of manufacture.

Before the indium collector and emitter pallets are alloyed to it, the germanium wafer forming the base of the transistor is measured for correct thickness. A special electronic method of measurement is used which is claimed to be accurate to plus minus 0.5 microns.

An ingenious machine has been developed by Mullard engineers in form of a rotary tinning device. It tins the ends of the fine wires which form the connections to the transistor base, emitter and collector. Tinning is done in such a way that a small "flag" of solder is produced to facilitate connections.

After undergoing further stages of manufacture the transistor assembly, complete with glass foot and connecting wires, is first pre-tested for electrical characteristics. Then it is inserted in its glass envelope, ready for sealing. Before pre-testing, the assembly is chemically etched to remove surface contamination. The pre-testing procedure is made in a hermetically sealed "dry box" containing a nitrogen athmosphere of controlled humidity. This prevents any subsequent contamination of the transistor assembly.

The above is only a very brief outline of manufacture proceedings of semi-conductors, but it will be realized from this survey how stringent testing methods have to be applied for production of simple looking electronic devices in the semi-conductor class. END

*Consulting Eng. & Technical Author, Painswick, England

An electron microscope is used to examine surface of single crystals of semiconductor materials

The large quartz spectrograph housed in this laboratory is used to detect small traces of impurities in semiconductor materials

This instrument measures the thickness of the germanium wafer base to accuracy of ± 0.5 microns

These girls have the delicate task of soldering connecting wires to emitter and collector (left), then inspecting the work (right)

Special rotary tinning machine was developed to tin the ends of the wires that form connections

Research to add to the ever-growing number of applications for semiconductor devices is one of the chief functions of this group

A space program for Canada— why not !

This article has been submitted by the Canadian Astronautical Society, Downsview, Ont. CAS seriously believes that Canadian participation in a space research program is both possible and desirable, and that Canada should start right now to take her place among the progressive nations in this great field

The British Interplanetary Society has made preliminary design for this unmanned moon probe rocket

The Ninth Congress of The International Astronautical Federation, held this year in Amsterdam, has now passed into history, but as far as Canada is concerned the close of this outstanding scientific event could in fact herald the early beginning of Canada's entry into an active Space Program.

Sceptics might dismiss this suggestion without further discussion. Where, they might say, are the huge sums of money required going to come from, and furthermore, they may add, everybody knows that the United States and the USSR are the only countries rich enough to undertake such programs. Well, on the face of things such comments seem initially to be quite justified and the recent change of Canadian defence policy would seem to lend extra force and meaning to them. However, if it is conceded that Canada might participate in a space research program rather than financing the whole operation, some of the more obvious difficulties show some promise of being overcome.

The concept of participation and the entry of a third contender into space explorations leads naturally to the idea of a Commonwealth Space Program. It is this idea that brought together several of the official Congress delegates, including that of Canada, into special session in Amsterdam. At this time a Commonwealth Astronautic Committee was appointed under the chairmanship of The British Interplanetary Society. The result of the first meeting of the committee took the form of passing unanimously a single resolution, which as a first step in implementing the program calls for a meeting of Commonwealth scientists to be convened in London, England, next year to study objectives and assess costs. The resolution itself also took the form of a press release and was given wide publicity in Europe and Africa, both in the newspapers and over the radio and is set out in detail here:

THE COMMONWEALTH ASTRONAUTIC COMMITTEE

Amsterdam, Wednesday, August 27, 1958

At the International Astronautical Federation Congress meeting in Amsterdam, it was decided today to set up a COMMONWEALTH ASTRONAUTIC COMMITTEE to assess the possibilities of Commonwealth countries engaging in joint activities in the field of astronautics.

Immediately preceding the next IAF Congress to be held in London in September, 1959, it is proposed to convene a Special Commonwealth Symposium, with the object of reviewing the possibilities of implementing such a policy. At this Symposium it is proposed to have strong scientific representation from the Commonwealth countries.

The Committee is at present composed of representatives of four countries: Great Britain, Canada, The Union of South Africa and India. Australia and other Commonwealth countries are expected to join later.

Commonwealth Astronautic Committee

The British Interplanetary Society, London, England.

The Canadian Astronautical Society, Toronto, Canada.

The South African Interplanetary Society, Johannesburg, South Africa.

The Indian Astronautical Society, Delhi, India.

Defining objectives must wait until September next year but it is interesting to speculate on what kind of program the Commonwealth could establish and, more to the point,

what kind of hardware and services could reasonably be brought to bear. Taking the second point first, the main propulsion stage could be the British Black Knight or the more powerful Blue Streak I.R.B.M. with upper staging employing solid fuel rockets. A combination of this sort would certainly compare favorably with the United States Army Jupiter C missile and the Air Force Thor-Able moon probe.

In regard to the researches to be carried out the field is very wide, and it is quite wrong to think that duplication of American or USSR programs would result. Scientists in both of these countries find room in satellites and probes to be at a great premium and the list of experiments awaiting execution is long, and will be so for many years to come.

The Commonwealth venture could take the form of an instrumented earth orbiting satellite, a moon shot, a solar probe or indeed any one of a dozen different research vehicles. The important point is simply that the Commonwealth is certainly capable of such a venture in terms of scientific resources and engineering ability and capacity and should take her rightful place in the research frontiers of astronautics.

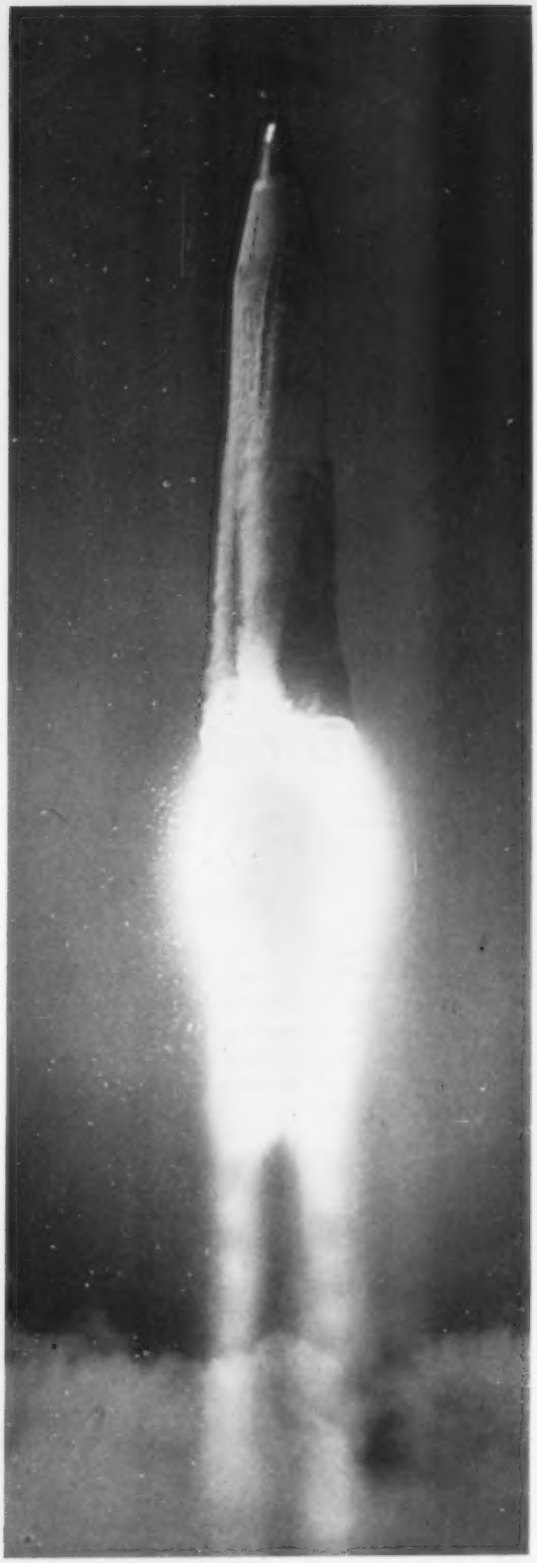
What does all this mean to Canadian scientists, engineers and industry at large? This, of course, would depend upon the details of the program. On a speculative basis one can visualize the valuable developments of The Canadian Armament Research and Development Establishment in the solid propulsion field as being directly applicable to the vehicle itself.

Participation in systems management, communications, telemetering, tracking, data reduction and ground handling are among the many areas in which Canadian industry and government laboratories are well qualified to be engaged, and the aircraft and electronics industries might well find themselves making significant contributions in any or all of these fields.

Early activities in the Commonwealth space research program would of course involve only a modest amount of activity in Canadian industry, but no doubt in the years ahead this would build up until a well-developed astronautic capability became established within the industrial complex of this country. Astronautics will certainly be big business in the future as it already is in the United States—the important thing is to make a start as soon as possible, no matter how humble. Let us at least try and take a first step—London in September next year provides one means of doing this. END

Founded in Toronto in 1957, THE CANADIAN ASTRONAUTICAL SOCIETY has for its primary objective the advancement in Canada of all the sciences and technologies embraced by the concept of manned space travel. Closely associated with other Commonwealth astronautical societies and represented at the Amsterdam Congress as an official delegate, the C.A.S. has high hopes that Canada will soon engage directly in important astronautical ventures.

As a backcloth to such activities, the Society promotes and maintains an organized exchange of astronautical information among its membership and by means of lectures, demonstrations and various publications serves the interest of the public at large. Experimental programs are also carried out by the Society. The present "CHARM" research rocket system and the "CLAMP" project (Canadian Lunar Antenna-Moon Probe) are examples of how the Society—in a very small way—tries to fill the astronautical vacuum presently existing in Canada.



Space vehicles are available at the present time in both Britain and the United States. This is the Atlas ICBM

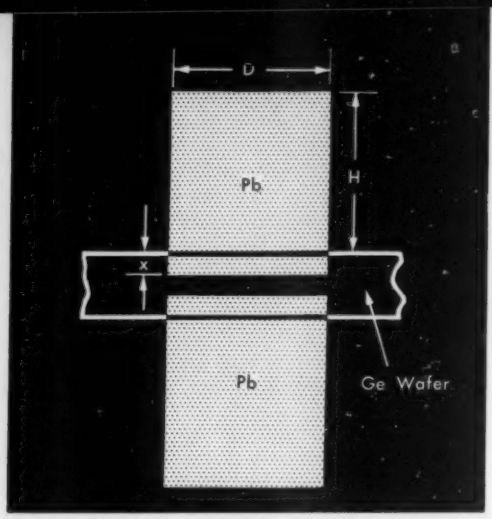


Fig. 1. Typical configuration of lead pellets and germanium wafer for alloying to make transistors

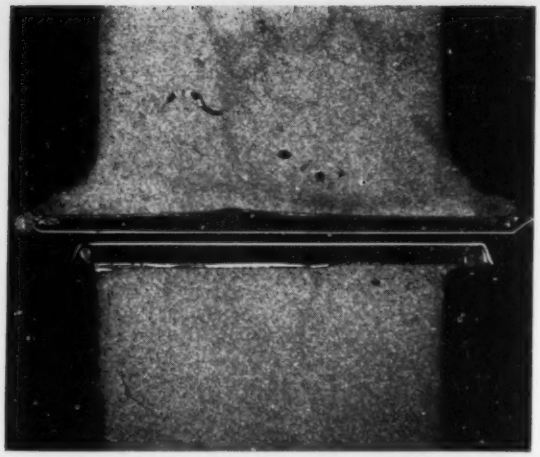


Fig. 2. Cross section through sample showing asymmetrical junctions caused by spreading of lead on top of wafer

Alloyed germanium transistor has symmetrical characteristics

OLAF STAVIK, M.S.S.*

Many of the possibilities of the alloying process were neglected when the trend toward diffused silicon devices was established. Some of the problems met in the production of a symmetrical alloyed transistor are described along with electrical characteristics of the device in both the normal and reverse directions

To those who have followed the rapid advances in the semiconductor field, the trend toward diffused silicon devices became clear several years ago. A silicon transistor or rectifier has the advantage over a similar germanium device that it will perform satisfactorily at a higher ambient temperature, a factor which is rather important in the field of missiles and satellites; and as a process, diffusion is far more flexible and lends itself better to large-scale production than any of the earlier methods for producing junctions. Viewed against such considerations, it may seem out of date to report on an alloyed germanium transistor. On the other hand, with the rapid advances in the semiconductor device development one cannot help feeling that a number of processes were never developed to full satisfaction because of the frantic search for new, and presumably better device processes.

The symmetrical alloy transistor is undoubtedly one of the stepchildren of the large family of transistors. The alloying process was only partly developed when diffusion became known as the favorite tool among the development pioneers, and many of the alloying projects were shelved in order to investigate the possibilities offered by the diffusion process. A symmetrical transistor should undoubtedly offer a large variety of useful applications, particularly as a switching device, and it should therefore be of interest to both the development and the design engineer to become familiar with the characteristics of such a transistor.

In the first section of this article we will review the basic theory of alloying as applied to an N-P-N germanium transistor and then relate some of the problems encountered in the production of a symmetrical transistor. The second part of the article will deal with the electrical characteristics of a symmetrical transistor. Measured values of the more common parameters will be listed for both normal and reverse operation.

Theoretical considerations of alloying Pb into Ge

It is assumed that the reader is familiar with the fundamental theory of alloying and we will therefore

*Northern Electric Company Ltd., Montreal.

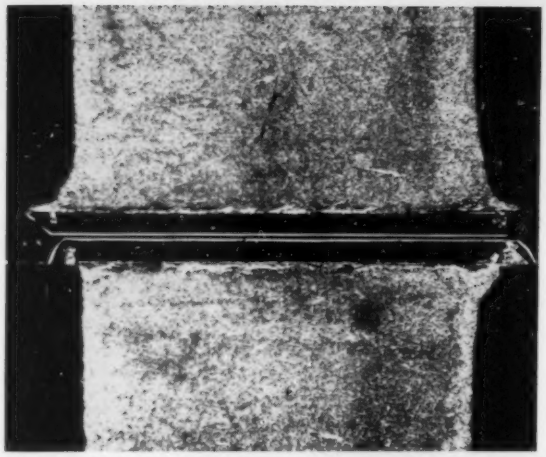


Fig. 3. Cross section through sample displaying good symmetry. Magnification from both Fig. 2 and 3 is x137

only review the calculations necessary to determine the depth of alloying of lead into germanium as a function of temperature and mass of lead. In order to form an n-p junction in p-type germanium, the lead must contain a small amount of a group V element, in this case arsenic. However, the amount of As is only of the order of 0.2% so that for all practical purposes, the arsenic can be neglected in these calculations.

Let us assume that the lead pellet is of cylindrical shape and that this shape is not altered during the alloying cycle (Fig. 1). Upon heating, the lead will dissolve germanium in a ratio indicated by the lead-germanium phase diagram.[1] With the germanium cut such that the surface of the wafer is parallel to the 1:1:1 atomic planes, the liquid-solid interface will follow the 1:1:1 plane. If N_{Ge} is the number of *Ge* atoms per unit volume and N_{Pb} the number of *Pb* atoms per unit volume, then the ratio (S) of germanium atoms to the total number of atoms in the melt is given by

$$S = \frac{N_{Ge}}{N_{Ge} + N_{Pb}} \quad \ldots\ldots\ldots\ldots (1)$$

Solving for N_{Ge} we get:

$$N_{Ge} = \frac{S}{1 - S} N_{Pb} \quad \ldots\ldots\ldots\ldots (2)$$

Converting this to volume we have:

$$V_{Ge} = \frac{S}{1 - S} V_{Pb} \times \frac{\text{Density } (Pb) \times \text{Atomic Weight } Ge}{\text{Density } (Ge) \times \text{Atomic Weight } Pb} \quad \ldots (3)$$

Inserting the values of density and atomic weight for *Pb* and *Ge* into Equation (3) gives:

$$V_{Ge} = 0.72 \frac{S}{1 - S} V_{Pb} \quad \ldots\ldots\ldots (4)$$

or

$$V_{Ge} = F(T)\, V_{Pb} \quad \ldots\ldots\ldots\ldots (5)$$

Where $F(T) = 0.72 \dfrac{S}{1 - S}$ $\quad \ldots\ldots\ldots\ldots (6)$

S is a function of temperature and is determined from the *Pb-Ge* phase diagram. V_{Ge} and V_{Pb} can be calculated with reference to Fig. 1.

$$V_{Pb} = \frac{\pi}{4} d^2 h \quad \ldots\ldots\ldots\ldots (7)$$

and $$V_{Ge} = \frac{\pi}{4} d^2 x \quad \ldots\ldots\ldots\ldots (8)$$

Where d is the diameter of the lead cylinder, h the height and x the depth of the melt (depth of alloying).

By substituting Equations (7) and (8) into (5) we arrive at the following simple expression for the depth of alloying as a function of temperature and height of lead:

$$X = F(T)\, h \quad \ldots\ldots\ldots\ldots (9)$$

During a study of alloying, 900 germanium wafers alloyed with $Pb - As$ were cross-sectioned and etched to reveal the two n-p junctions. The depth of alloying and the height of lead was measured for all the sectioned samples. The results indicated complete agreement with equation (9). A change in the rate of heating and cooling from 5 C per min. to 90 C per min. in the alloy cycle had no marked effect on the perfection of alloying. The wetting properties of $Pb - As$ on germanium was also found to be independent of the rate of heating and cooling and of the quality of the germanium. Good wetting was invariably achieved provided the surface of the germanium was scrupulously cleaned. In some instances breaks in the junctions were observed. These were found to be caused by foreign particles on the surface of the wafer, such as carbon dust from the alloy fixture which prevented wetting over a minute area.

The major obstacle in making a symmetrical transistor is obviously that of achieving perfect alignment and identical size of the two n-p junctions. This first of all implies correct physical alignment of the two lead alloy dots. In practice this is mainly a problem of proper design and machining of the alloy fixture.

Secondly, there must be no spreading of the lead on the surface of the wafer during the alloying cycle. Spreading will first of all upset the relationship given by equation (9) but what is more serious, spreading invariably results in unsymmetrical junctions. This is indicated in Fig. 2 where spreading on the top side of the wafer resulted in the top junction being considerably larger than the bottom. The alignment of the two alloy dots, however, was perfect.

Fig. 3 shows a micrograph of a sample displaying what we consider good symmetry. The micrographs shown in Fig. 2 and 3 were taken with dark field illumination so that the highly polished germanium wafer shows up only as a dark field between the two alloy dots. The junctions were brought out with a 5:1 HNO_3-HF etch.

The importance of cylindrically shaped alloy dots should be clear to the reader. Both theory and experiments indicate that in the case of a cylinder, the depth of alloying is a simple function of the height of the cylinder and the alloying temperature. One can therefore closely control the depth of alloying merely by adjusting either one of these two parameters. Secondly, it is relatively simple to produce two symmetrical junctions by this configuration. During the

Table 1

	Frequency Cut-Off $f\alpha$ (mc)		Current Gain α_{cb}		Collector Capacitance C_{co} uuf		Leakage Current ua		Voltage Breakdown (volts)		External Base Resistance $r_b{}'$ (ohms)	
	N	R	N	R	N	R	I_{eo}	I_{co}	V_{e-b}	V_{c-b}	N	R
1	2.5	2.5	29	29	9.8	9.8	5.5	4.5	45	50	78	78
2	3.3	3.5	30	31	10.5	13.5	5	5	35	45	140	140
3	5.4	5.4	40	40	11.5	11	5	5.5	55	53	250	250
4	6.0	6.0	40	41	11	11	5	5	55	50	80	80
5	6.5	6.5	34	36	19	19	3	3	40	40	48	48
6	7	7	32	34	12	12	6.5	5	40	40	55	55
7	8	7.6	35	32	17.5	17	4.2	4	45	45	72	72
8	11.5	11	56	56	17	17	5.5	5	45	50	44	40
9	13	12	70	68	17	17	5	5	43	50	55	55
10	13.5	13.5	52	48	18	18	3	3	45	45	85	85

N—normal operation. R—reverse operation.

alloy study mentioned earlier, it was found that the physical shape of the alloy dots was affected by the amount of As in the lead. The ideal cylindrical shape featured in Fig. 3 was achieved with lead containing 0.2% As. Increasing the As content beyond 0.5% resulted in irregularly shaped alloy dots.

It has been stated in the past that alloying, as a process for producing n-p junctions, is a "chemical-physical-metallurgical nightmare." It is possible that in the development stage alloying displays such an unpredictable temperament as to justify this colorful description. However, once the proper conditions have been established, the desired result—illustrated in Fig. 3—can be very consistently reproduced at high yield.

Electrical characteristics

Before presenting electrical data on a transistor which we claim is symmetrical, it would seem appropriate to explain just what we mean by symmetry. The transistor referred to in this paper was designated TG-31. By symmetrical we refer to those transistors which meet the standard set of TG-31 specifications for both normal and reverse operation. This definition merely states that the unit will operate as a TG-31 transistor both in the normal and reverse direction. It does not, however, imply that the emitter and collector are matched.

By symmetrically matched transistors we refer to those units where the deviation between normal and reverse operation for frequency cut-off ($f\alpha$), current gain (α_{cb}) and leakage current (I_{co}) is less than 10%. Approximately 70 and 30% of the TG-31 transistors meet the first and second definition respectively.

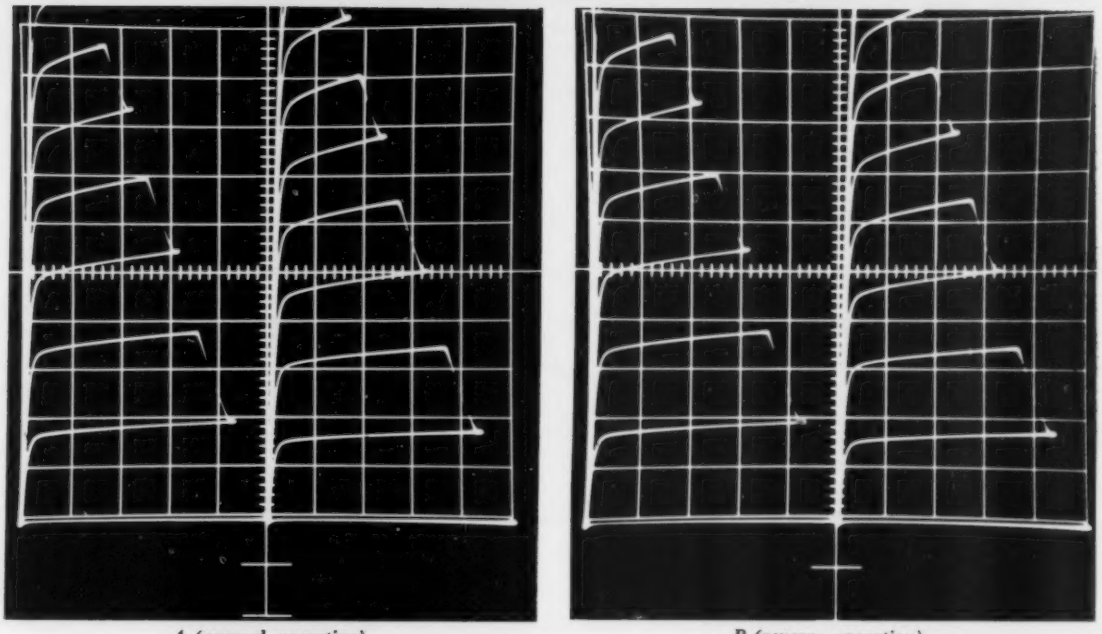
In Table 1 are listed the more common characteristics for both normal and reverse operation for ten transistors where the deviation in current gain (α_{cb}) between normal and reverse operation is less than 10%. The current gain was measured at $V_c = 4$ volts and $I_e = 1.0$ ma.

Looking at the other parameters listed in Table 1, it is seen that the greatest deviation occurs in the voltage breakdown V_{cb} and V_{eb}. This is of course to be expected because this parameter is not entirely a function of design and material but is affected by the cleanliness of the junctions. However, V_{cb} and V_{eb} should have no obvious effect on the symmetrical behavior of the transistor as long as the unit is operated well below the lowest turn-over point. The deviation in leakage current I_{co} for transistors (1) and (6) is more than 10%, but aside from these, all parameters are symmetrical to within 10%.

Figs. 4 and 5 show families of curves for grounded emitter operation for transistor (7). (a) and (b) refer to normal and reverse operation respectively. The photographs were taken on a Tektronix Type 575 Transistor Curve Tracer.

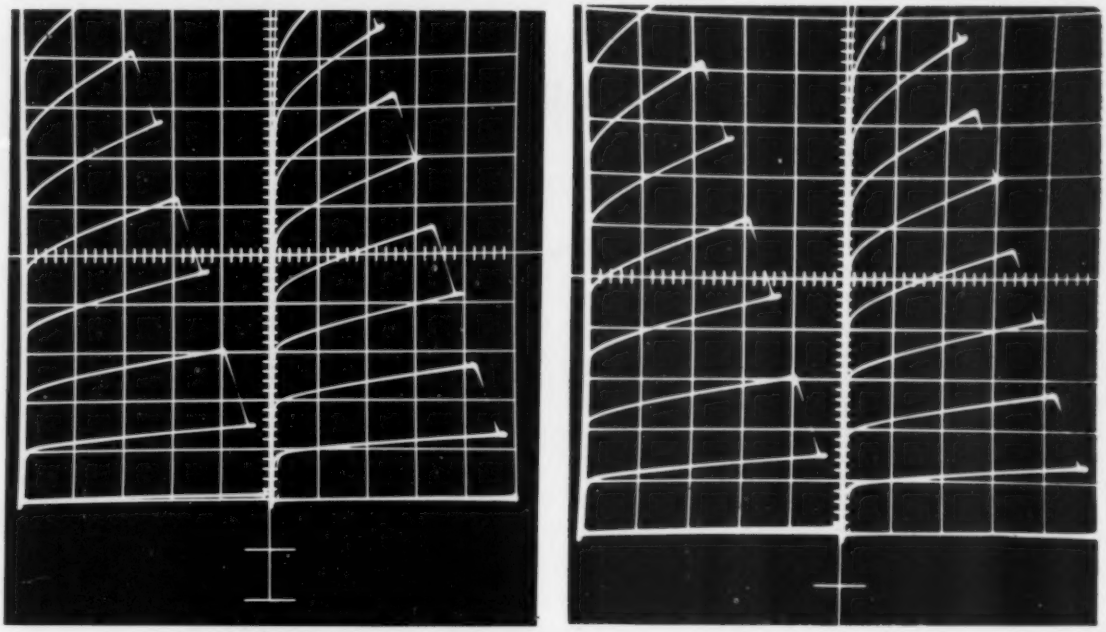
The difference in collector current between two adjacent curves at a given collector voltage divided by the base current step gives the current gain α_{cb} directly. At $I_c = 100$ ma and $V_c = 1.0$ volt, the current gain is approximately 28 and 25 for normal and reverse operation respectively (See Fig. 4) as compared to 32 and 30 at $I_c = 1.0$ ma and $V_c = 1.0$ volts (See Fig. 5). That is, the current gain (α_{cb}) at $I_c = 100$ ma is approximately 90% of the gain at $I_c = 1.0$ ma. The deviation in α_{cb} between normal and reverse operation remains closely the same with a variation in I_c from 1–100 ma. Increasing V_c does not upset this correlation, as can be seen in Fig. 4. The emitter and collector of this transistor therefore display matched characteristics over the total operating range of the unit.

Table 1 presents a representative sample of the units referred to as symmetrically matched. In practical applications such a unit can be reversed in its position in a circuit without affecting the behavior of the circuit. We feel that this particular characteristic should present many new and interesting applications to the circuit designers. The fact remains, however, that the symmetrical transistor has been gravely neglected in the past. A possible explanation for this may be that the majority of transistor circuit



A (normal operation) *B (reverse operation)*

Fig. 4. Grounded emitter characteristics, Vertical: I_c=10 ma//div. Horizontal: V_c=2 v/div. Base current steps 0.02 ma/div



A (normal operation) *B (reverse operation)*

Fig. 5. Grounded emitter characteristics, Vertical: I_c=0.5 ma/div Horizontal: V_c=2 v/div. Base current steps 0.02 ma/div

designers consider the transistor as the equivalent of a vacuum tube triode and thus the potential symmetry of the transistor has remained hidden in the shadow of its great thermionic rival. END

Acknowledgements

The author takes great pleasure in acknowledging the aid of his colleagues, Mr. S. D. Rosenbaum, M.S.S., Mr. E. Hicks, Eng. Dept., and Mr. G. Swain, Tech. Assistant.

References:

1. *Smithell's Metals Reference Book, Vol. 1, second edition, page 399.*

Characteristics of Alcan Coatings	Type 100	Type 200
Appearance (partially sealed)	Yellow	Light green
Composition — Sulphates, % by weight	11-14	11-14
— Chloride, % by weight	Nil	1-3
— Hydrated oxide	Remainder	Remainder
Thickness (maximum), microns	12 (0.00047 in.)	12
Apparent density, grams/cc	2.3-2.9	1.7-1.95
Resistance to deterioration on bending	Fair	Good
Insulation breakdown voltage, 0.0508 in. dia. wire		
Mandrel 10 x wire diameter, polished steel—1 film	175	100
NEMA dielectric twist, between wires—2 films	350	200

G. R. PINK, P.ENG.*

Anodized aluminum wire

Aluminum wire with a coating of aluminum oxide formed by a continuous anodizing process shows excellent properties as an insulated conductor. The oxide has a high dielectric constant, remains stable up to the melting point of the underlying aluminum, takes up almost negligible space, and has good mechanical properties. This material should find many applications, particularly where high temperature operation is necessary

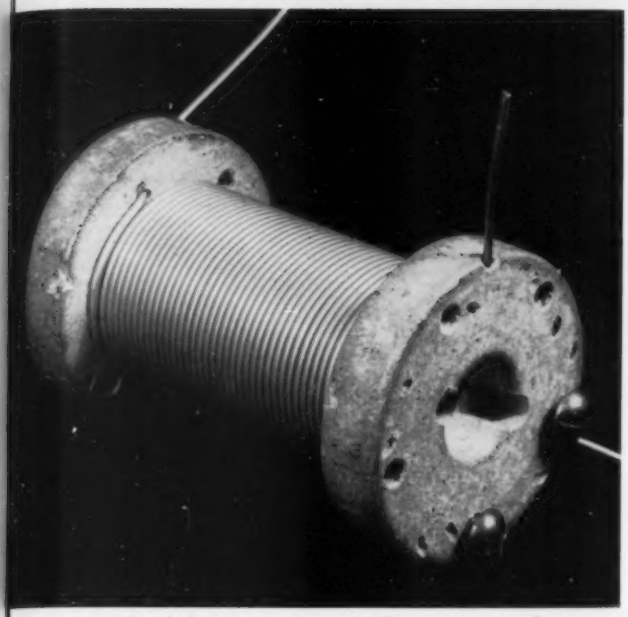
The demand for higher operating temperatures, particularly in modern aeronautical electrical components, greatly exceeds the capabilities of most commercially available insulants. Manufacturers have been turning to ceramic materials and to the attractive properties of aluminum oxide on aluminum. The electrical insulating property of aluminum oxide is virtually unaffected by temperature.

Historical background

The best known use of aluminum oxide for electrical insulation is in electrolytic capacitors. A layer of aluminum oxide is formed on aluminum foil by anodic oxidation or "anodizing." The thinness of the oxide coating and its high dielectric constant are decided advantages in providing capacitors with high capacitance per unit volume. Such capacitors have been in common use for 30 years but little attention was paid to other applications for the electrical properties of aluminum oxide until the late 1940's when equipment suitable for high temperature operation was gaining in importance. A number of patents were issued to European manufacturers covering electrolytes and methods of making contact with the wire in a continuous production machine.

In 1953 Alcan began the development of a method of continuously anodizing aluminum wire suitable for North American industrial needs which would have a coating tough enough to withstand normal handling, a constant dielectric strength and be able to be bent around mandrels of a reasonable size with no reduction in properties. In 1957 a production plant capable of anodizing three wires

*Aluminum Company of Canada Ltd., Montreal.



Anodized aluminum wire on bobbin used for insulation test

Advantages of anodized aluminum wire

Application	Less weight	Lower cost	High temperature performance
Electromagnets	✓	✓	✓
Magnetic brakes and clutches	✓	✓	✓
Ignition coils, solenoids, etc.		✓	
Aeronautical and other electrical equipment	✓		✓
Coils for electronic equipment		✓	✓

is good for 600 deg C

simultaneously went into operation. Depending on the thickness of the coating required, speeds of 30 ft. per minute and higher can be achieved. By modifications to the electrolyte two coatings having slightly different properties are available, Type 100 and Type 200. Their characteristics are given in the table opposite.

Valuable properties

The heavy layer of aluminum oxide formed on the wire by continuous anodizing has a high dielectric constant, is chemically inert and has a melting point well in excess of that of the underlying aluminum. Formed by an electrolytic process, this oxide layer is very hard but porous. Furthermore, although the oxide layer adheres strongly to the underlying aluminum, it will develop minute cracks when bent or heated. For this reason an anodized layer of aluminum oxide on aluminum is basically a spacer type of insulation, and one which remains stable up to the melting point of the underlying aluminum, approximately 600C. Tests indicate that Type 200 has two-thirds the resistance to abrasion of the Formvar coatings used on copper.

The aluminum oxide layer is less than 0.0005 inch thick and therefore has a negligible space requirement in a coil. This can sometimes make up for the increased size of aluminum wire necessary for a current carrying capacity equivalent to copper. The electrical conductivity of aluminum conductor wire is 61% I.A.C.S. The thin aluminum oxide layer also allows quick heat dissipation from inside the coil.

The thin, hard coating also has sufficient wear resistance to allow it to be used in most high speed coil winding machines.

Light weight is another important factor. A coil of anodized aluminum wire has virtually the same weight as a similar coil of bare aluminum wire. The density of aluminum is 0.098 lb per cu in, while that of copper is 0.322 lb per cu in.

The aluminum oxide coating is an excellent base for overcoating with other insulating materials. Its presence will ensure positive separation of conductors and help to provide continuous operation even under overload conditions that would damage the primary insulation.

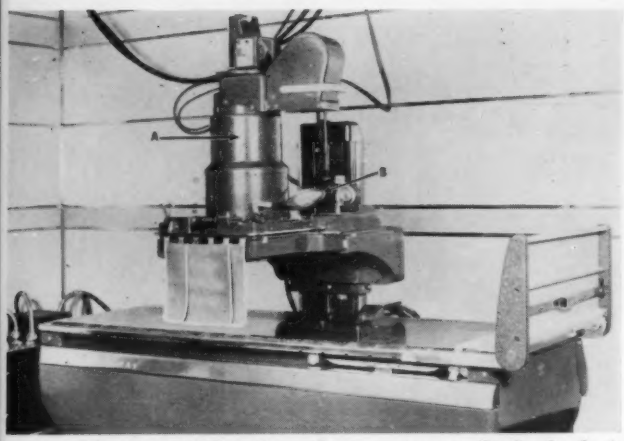
The cost of anodized aluminum wire is low.

Some typical applications of this new material are listed in the table above, which also shows the relevant advantages.

Future prospects

A substantial increase in use in proven applications is anticipated and, in addition, there are signs that the unique properties of anodized aluminum wire may be applied to entirely new designs in the electrical field.

Anodized aluminum wire can be used most advantageously in coils where the voltage from turn to turn is low and where an increase in physical size can be tolerated. Economics usually favor aluminum in this case and its resistance to high temperature is an added attraction. Where high temperature operation is really necessary, anodized aluminum wire is equal to the best. Where the bulk of the coil is not important, aluminum can be an economical alternative for organic-insulated copper wire. END



X-ray: In Picker X-ray Corp. equipment, Rauland tube is mounted in (A). Physician sees the image in mirror (B)

X-ray: Rauland X-ray image tube covers larger area than many small-screen tubes. Two circles show the difference

X-ray image amplifier aids physicians

The Rauland Corporation, a subsidiary of Zenith Radio Corporation, has introduced a new x-ray image amplifier with which the physician can view an image at least 350 times brighter than that on a fluorescent screen, and reduce substantially the total amount of radiation to which both patient and physician are exposed during x-ray examination.

The brilliant image and large size pick-up screen of the amplifier permit good visualization of the entire adult heart, of the complete stomach, or of the colon while barium salts are moving through, and other portions of the body which are too thick to permit a bright enough image on a flourescent screen even with excessive radiation.

The image tube was developed by Dr. Wilfred F. Niklas, an expert in the field of electron-optics and in charge of Rauland's advanced tube design section.

The pick-up screen of the image tube supplies a useful area of at least 41 square inches, in contrast to other image tubes used for medical x-ray that have a viewable field of about 16 square inches.

Because of the screen's large area, the physician requires less time to locate the region he wants to scrutinize, thus reducing the patient's exposure time to radiation. Further the high brightness of the image on the amplifier tube permits the diagnostician to cut down x-ray intensity and still achieve an image better in quality than that obtained by fluoroscopy without an image converter. The diagnostician, who is exposed to x-ray frequently, and in some cases daily, can even eliminate radiation to himself by viewing the image on a TV screen located in another room. If desirable, he can also make use of the closed-circuit TV method for consultation purposes with other physicians.

The large area of the pick-up screen permits viewing of the entire pulsing adult heart and surrounding area during surgical procedures, and makes advanced studies possible, including the introduction of a catheter into the heart chambers. Such a study of the heart by image amplification, moreover, requires only one tenth as much radiation intensity as by fluoroscopy.

According to tests by Rauland and Picker X-Ray Corp., the new tube—when using standard x-ray intensities—makes it possible to see the contrast between only 1½ to 2½% x-ray absorption differences in areas ranging from a diameter of 3/16 in. to ¼ in., as compared to at least 6% required for a fluoroscopic screen. The ability to show these minute contrast differences is particularly significant in x-ray viewing of the abdominal region, where depth of the human body is generally at its greatest.

The tube allows varied methods of x-ray presentation, one of which is direct viewing of the magnified image through an optical system built into the x-ray equipment.

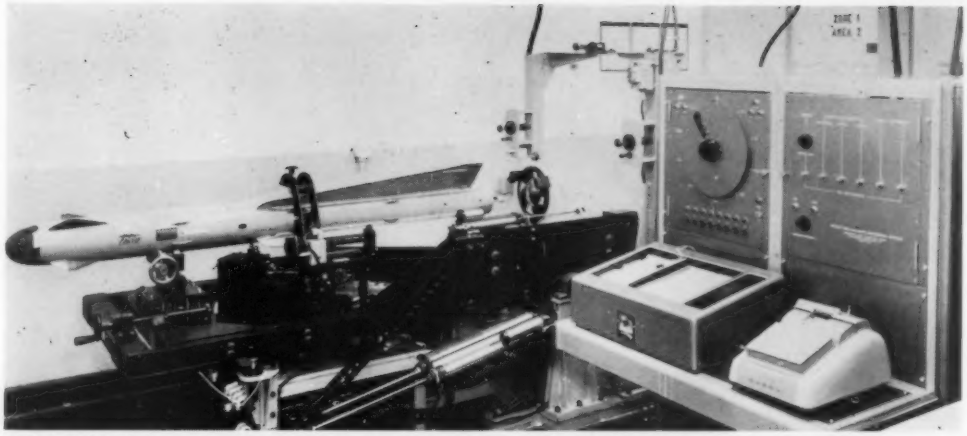
Automatic tester checks Falcon guided missiles

A new automatic device that tests Falcon guided missiles as fast as they leave the production line has saved the Hughes Aircraft Company, Tucson, Arizona, $10,000 in costs alone during the first six months that it has been installed.

The device is known as the Aircraft Missile Weight and Balancing System. It was designed and built by the Electronics and Instrumentation Division of the Baldwin-Lima-Hamilton Corporation, Waltham, Massachusetts.

The equipment determines the centre of gravity (C.G.) and thrust alignment of the Falcon missile.

The quality control instrument for testing the Falcon



Falcon: Special test jig determines centre of gravity and thrust alignment of Falcon missile

missile uses two specially designed B-L-H SR-4 sensing elements and one standard SR-4 load cell. The SR-4 elements and cell, strategically located in the missile stand, enable the instrument to plot the missile's characteristics at the rate of one missile every five minutes.

Generally, the system works in this way:

The Falcon missile leaves the production line on an overhead monorail and is lowered horizontally by an air hoist onto the missile platform.

The missile is lined up on the platform by a pin which fits into a tooling hole in the missile and is then retracted. The weight and longitudinal C.G. measurements are made while the missile is in this horizontal position.

The Falcon rests on rollers while being lined up horizontally. When the missile is in this position, the operator lowers the missile so that it rests on a cradle mounted on a load cell which weighs it. The cell used is a UIB SR-4 load cell. A Clary printer stamps the weight automatically on the chart.

After the longitudinal C.G. and the weight are recorded on the data chart, the chart is taken from the printer and placed in a Moseley X-Y Plotter, also mounted on the console. The plotter records the lateral C.G. and thrust alignment.

To determine the lateral C.G. two measurements are made, both while the missile is still in its horizontal position. An initial measurement—lateral C.G. "X"—is made. The missile is then rotated 90 degrees around its long axis, and a second measurement—lateral C.G. "Y"—is made. The summation of these two readings are recorded as the lateral C.G. reading.

Thrust alignment deviation is then determined by the machine which measures the distance in inches between the true C.G. of the missile and the point at which the true vertical, the projected centre line of the SR-4 pickup, intersects the longitudinal C.G. line.

This thrust alignment measurement is achieved by two special SR-4 bonded wire strain gauge beams attached to the mandrel. The beams detect moment which is the weight of the missile multiplied by the thrust alignment deviation.

The beams, operating on the basis of inverted pendulums, provide separate pickups for deviations in two right vertical planes through the longitudinal axis of the mandrel. The Moseley plotter charts the resultant of the two pickups.

Steel mill is controlled by electronic system

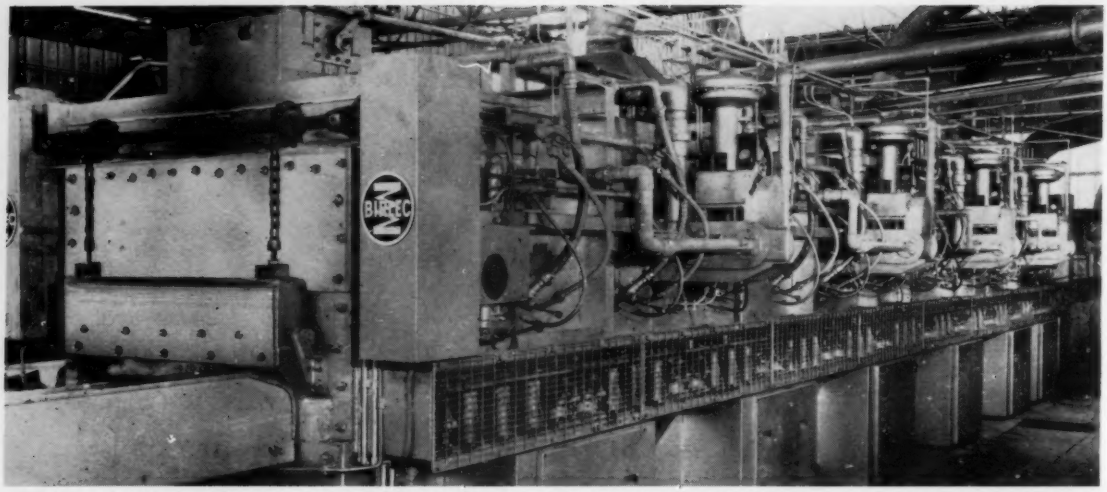
A new electronic control system is incorporated in the gas-fired, roller hearth annealing furnace which has recently been installed by Birlec Limited in the new stainless steel mill of Talbot Stead Tube Limited, Walsall. It is used for the heat treating of stainless steel tubes either on a continuous or batch production basis. Considerable use has been made of Warner electromagnetic brakes and clutches to provide over-all remote control.

The furnace which can turn out one ton of steel per hour comprises four sections, a loading table, furnace chamber, spray quench booth and unloading table. The hearth of each section consists of a series of rollers mounted adjacent to each other and chain driven to enable tubes up to 40 ft. long and 8 in. o.d. to be carried completely through all four sections.

The furnace chamber which is pressurized, is divided into four zones. By means of specially designed Birlec control valves, the products of combustion form a controlled atmosphere, thus doing away with any supplementary gas plant. This produces a controlled oxidation on the surface of the steel which has the effect of reducing considerably, the pickling time.

Temperature controls and pressure controls are by means of Honeywell Brown pneumatic instruments.

The furnace is controlled from three control desks, situ-



Steel mill: This is the inlet door end of the Birlec roller hearth annealing furnace. Over-all length is 165 ft.

ated along the length of the furnace. The main sub-contractors for the control gear to Birlec Limited, were Teledictor Ltd. who were also responsible for the design and construction of the electronic counting equipment and other apparatus.

Six clutches and two brakes are used to allow the whole furnace to be remotely controlled to a given operating sequence. A clutch and brake couples the main 12.5 hp drive motor to the main roller shaft on the loading table, via a variable speed gear box. This shaft is, in turn, coupled to the roller shaft of the furnace chamber via a clutch coupling. A further clutch couples the furnace chamber shaft to the roller shaft in the spray quench section and this shaft is coupled to the roller shaft on the unloading table.

A one-hp 1,440-rpm motor, together with its 120:1 reduction gear is coupled by means of a further clutch to the roller shaft in the furnace chamber. This enables the rollers to be driven backwards and forwards during the heating process to avoid distortion within the furnace. A clutch coupling with a brake fitted to the output shaft of a 30-hp, 940-rpm drive motor and this clutch couples the motor to the roller shaft of the spray quench section so that when engaged the spray quench rollers are driven at a high speed.

One of the biggest problems which had to be faced on this application was the fact that during the acceleration and deceleration of the rollers in the individual sections, it was absolutely vital to avoid these rollers skidding and, consequently, scoring the tubes. The roller system in each section called for a high starting torque characteristic but once the rollers begin to revolve the driving torque falls to approximately 50% of the starting torque figure.

To accommodate for this, it was necessary to provide an electronic closed loop servo controlled system for the main drive clutch and the high speed drive clutch so that at all times the rollers were accelerated and decelerated at a controlled rate to prevent the tube skidding on the rollers. All the other clutches revolve at very slow speeds and are controlled by pre-set potentiometers to give the optimum driving torque and protect the drive chains etc.

The whole furnace is automatically controlled to provide either continuous or batch production. During continuous operation, the clutches of each of the four sections are engaged to enable the main clutch to drive the whole furnace so that the tubes are continually passing through the furnace. In batch production a complete automatic sequence is established in the following manner.

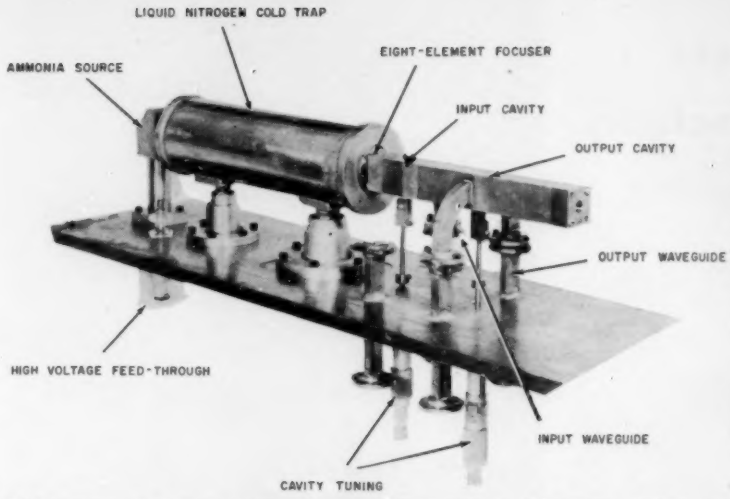
Tubes which have been placed on the loading table are driven into the furnace chamber by engaging the main drive clutch and also the furnace clutch. When the tubes have moved into the furnace, an electronic counting device causes the drive to be stopped.

An automatic sequence is now started which causes the oscillating drive clutch to be engaged and the motor started. This drive causes the furnace rollers to be turned backwards and forwards a predetermined amount by the reversing of the oscillating motor. During the time that the tubes are in the furnace, a second batch of tubes can be loaded on to the loading table.

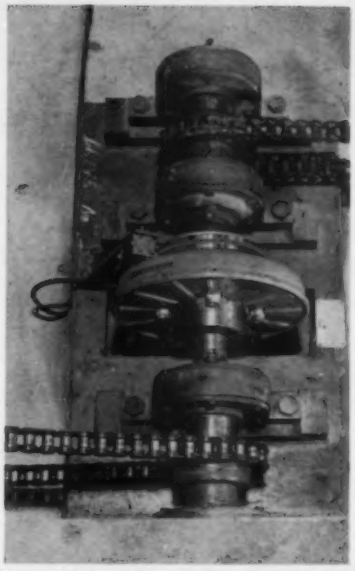
When the correct time has elapsed, the operator causes the high speed clutch to be engaged together with the furnace and spray quench clutches so that the tubes are rapidly withdrawn from the furnace and deposited in the quench section. The counting equipment operates as before to stop the drive when the tubes are in the correct position for quenching. The tubes on the loading table can now be driven into the furnace chamber.

Atfer quenching the tubes are driven onto the unloading table by means of the high-speed clutch and motor.

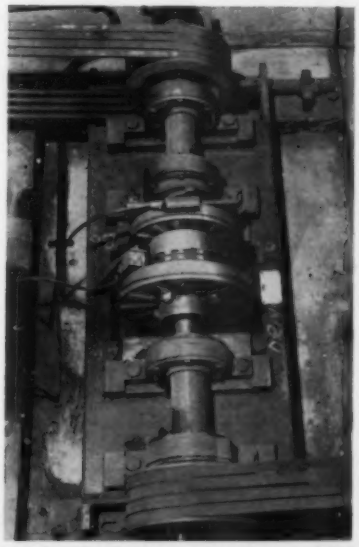
Whenever the main clutch or high-speed clutch is engaged, an electronic servo arrangement comes into action, which allows controlled acceleration and deceleration to be achieved irrespective of the load which the clutch has to work against. Normally, on any movement the sequence is that the load is accelerated to full speed in a period of between five and ten seconds. It then moves to a position just short of the required distance when it decelerates to a very slow speed, at which it moves forward to its final position. All the speed variation is obtained by control of the Warner clutches.



Philco maser is first to demonstrate unilateral gain in microwave energy by means of 2 electrically isolated cavities connected by beam of gas molecules



Steel mill: Electro magnetic clutch for oscillating drive to the furnace



Steel mill: Clutch and brake assembly between 12½ hp motor and gear box

Gas maser operates on new principle

Allen C. Munster, Director of Research for the Government and Industrial Division of Philco Corporation has released some data on a new type of gas maser. The maser study was conducted by Philco for the U. S. Army Signal Engineering Laboratory, Fort Monmouth, N.J.

The new maser is the first "atomic" amplifier to demonstrate unilateral (one-way) gain of microwave energy by means of two electrically isolated cavities connected by a beam of neutral ammonia gas molecules. Energy is transferred from one electromagnetically isolated point to another by the flow of these molecules.

As the oscillating molecules pass through the second cavity, electro-magnetic radiation is developed and it appears in the output waveguide. Thus is achieved unilateral amplification without aid of electronic effects.

The original concept of amplification and oscillation by uncharged molecules through use of a maser was demonstrated by Columbia University in 1955.

Prior to the development of the Philco "atomic" amplifier, all maser amplifiers were basically bilateral devices and had all the problems of common input-output terminals.

Just as electronics has achieved its greatest versatility and reliability through the inherently unilateral amplifying property of vacuum tubes and transistors, the new unilateral maser promises equally important applications for atomic amplifiers.

Masers have excited the electronics industry because they remove the noise inherent in conventional electronic devices. They can provide amplification approaching the theoretical limit of no extraneous noise.

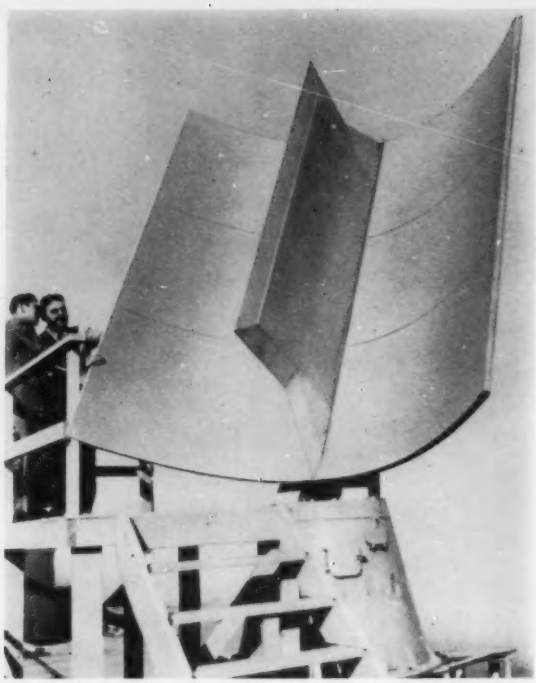
The new maser also has demonstrated the predicted physical phenomenon of prestimulation of molecules in an excited state. Prestimulation in a two-cavity device promises to provide a greater degree of freedom for controlling the gain-bandwidth properties of an "atomic" amplifier.

Masers are still on the threshold of a scientific frontier, but soon new systems will be evolved. Their successful operations will depend either upon very low noise amplification or very high oscillator stability which represents a dramatic technological break-through for electronic components.

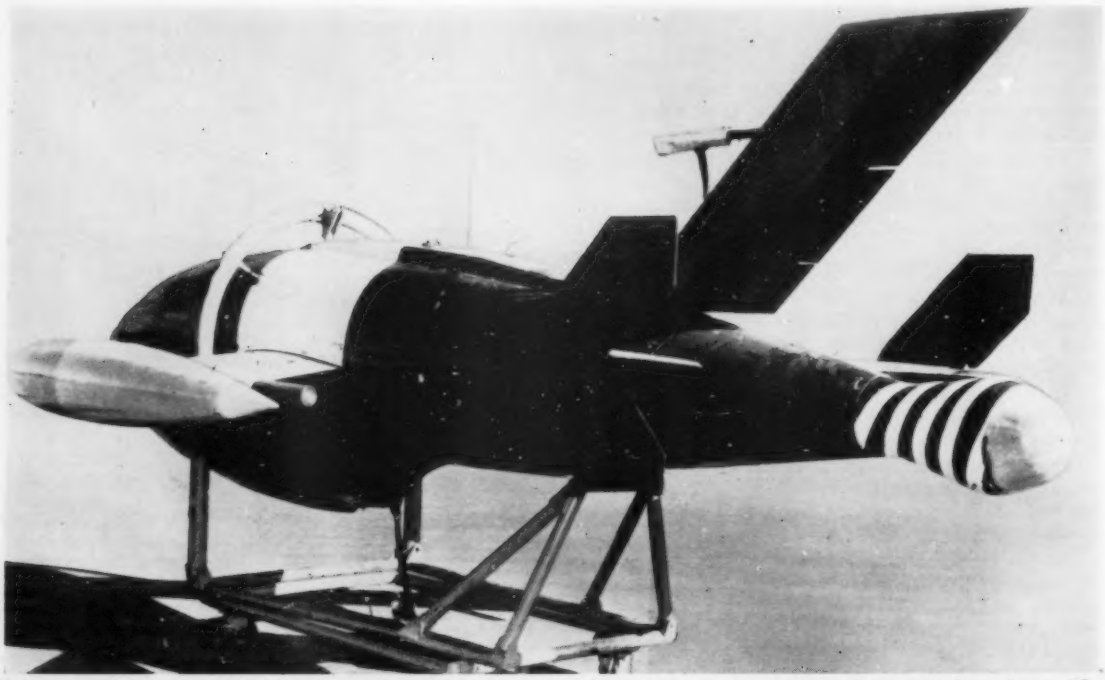
END

These developments show diversified activity in field of engineering

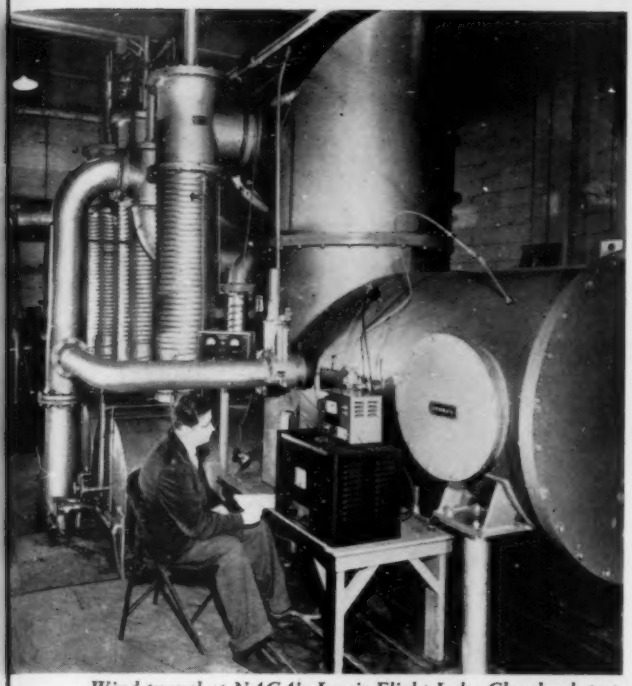
Twin keyboard typewriter developed by The Imperial Typewriter Co. Ltd., England, facilitates the typing of mathematical and scientific reports. Carriage will shift back and forth in register with 180 characters.



This radar reflector of metal sandwich design for shipboard installation weighs approximately half that of a conventional tubular truss structure. Manufacturer is Narmco Manufacturing Company, La Mesa, California.

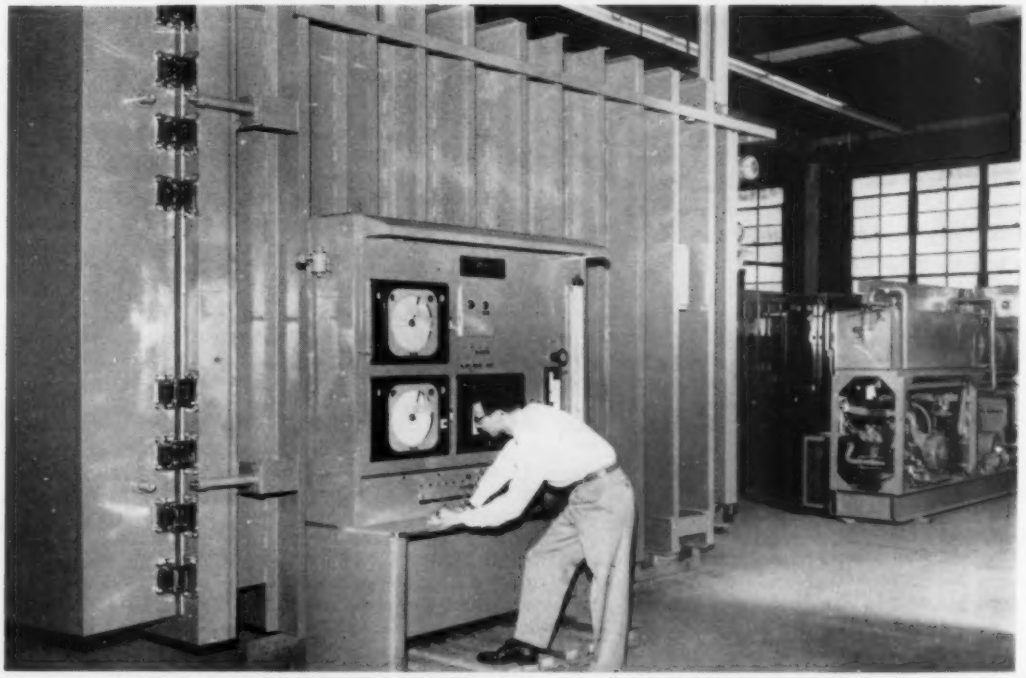


The Ecco reflector mounted on the tailcone of the Ryan Aeronautical Co. Firebee provides strong radar echoes. The Firebee target drone then has a reflection factor comparable to a large bomber. The reflectors, based upon the Luneberg lens principle, are mounted on the wing tips too. The Ecco reflector is built by Emerson & Cuming, Incorporated.



Wind tunnel at NACA's Lewis Flight Lab., Cleveland, tests behavior of instruments at flight speeds from Mach 2 up to Mach 8, and altitudes to 75 miles. Pumping system and control panel is from Stokes Corporation, Philadelphia.

This is a good example of modern industrial design. It is a special oscillograph at the Institute of Nuclear Problems of the USSR Academy of Sciences. It is used during operation of the huge synchro-cyclotron at Dubna.



Tenny Engineering Inc., built this environmental test chamber for testing military equipment at Stromberg-Carlson. It contains a 6,000 pound vibration machine, has a temperature range of -120 F to + 350 F, humidity range of 20 to 95%, and an altitude ceiling of 100,000 feet. The steel chamber measures 8' high, 8' wide and 12' deep in the inside.

British Amateur Television Club members Lowe (left), Barlow and Harper discuss tv equipment they have designed

Amateur tv club plans ambitious program

ANTHONY BRIAN, MONTREAL EDITOR.

The Canadian branch of the British Amateur Television Club is now one year old. Its members from coast to coast are engaged in teaching tv fundamentals, designing circuits and planning experiments. They would like to hear from other people interested in this activity

There are more ways than one to build television equipment. Producing circuitry that does not use expensive or rare components or tubes and which can easily be set up with the minimum of test gear is one of the prime objects of the British Amateur Television Club.

Thanks to the fact that Mike Barlow, livewire of the parent organization, now makes his home in Montreal, the one-year-old Canadian branch of the club is getting its heels dug-in to an ambitious program.

Difference between this club and many others in the same field is that the BATC is mainly for theorists and experimenters rather than for "hams" whose main aim is to "get on the air." Says Barlow: "Fully 80% of BATC (with a world-wide membership of 550 in 18 countries) have no interest in going on the air; closed-circuit transmissions give plenty of scope for experiment, and save the cost of transmitters and licences."

At the moment there are only some sixteen members in Canada, spread from Nanaimo in the west to Truro in the east. Activity centres around the Toronto-Hamilton area, and in Montreal.

So far the Canadian branch has mainly been concerned with teaching local enthusiasts the fundamentals of TV and how the techniques can be simplified for amateur work. In general the club is working along lines similar to industrial TV.

The club publishes a journal, "CQ-TV," with technical articles on how to make substitute parts. Many of the circuits developed by members are quite original in concept.

Department of Transport restrictions which the club hopes to have removed are the requirement for a morse test before a transmission licence is granted (no morse test is required in the U. K.) and the restriction on duplex operation either on one band or cross-band (which would be most useful in setting up TV transmission over paths of more than a few miles).

Future plans are directed toward determining a set of simple circuits for all TV units; to producing literature of real value to the amateur TV enthusiast; to standardizing techniques and directing the experiments of members so that units and signals are interchangeable and each person does not have to build an entire TV station of his own. There is even talk of color TV experimentation.

Mike Barlow, at 1740 Hartenstein Street, St. Laurent, Que., would be pleased to hear from anyone interested in the club. END

Donald G. Fink, President of IRE (left) had a busy schedule during the convention. Among other things, at the banquet (centre) he brought greetings from the Institute. Most engineers were very busy too. E. V. Hird, Lenkurt Electric Co. of Canada worked hard co-authoring a paper and demonstrating his equipment in the Automatic Electric booth

Electronics industry surprised itself

The 1958 IRE Canadian Convention was better than ever!

The 1958 IRE Canadian Convention and Exposition opened with a note of despair. Prime Minister Diefenbaker had just announced cancellation of Astra and Sparrow, plus uncertainty on Arrow

Prior to this the Canadian electronics industry had struggled through a period of poor consumer product sales, few defense contracts and a general tightening down of the Canadian economy

Some members of the industry had voiced opposition to holding an annual show. They maintained that the volume of electronics business in Canada did not justify this large sales expense each year

Final attendance figures surprised even the most optimistic — 10,142. Of these, 9,122 were technical and 1,020 public visitors. In 1957 they were 7,647 and 1,002; in 1956: 7,818 and 2,220

The gloom and indifference of opening day soon changed. Most exhibitors had better sales leads this year than ever before. Better selling methods and products attracted the engineers

The technical sessions provided the best indication of Canada's ability in research and development, as well as in production and service. We must do everything possible to preserve this national asset

More than 100 of the 119 technical papers were by Canadian authors. At any one time, an average of 390 engineers were in attendance, with session on stereophonic disc recording drawing top audience.

The results this year have pretty well assured the future of the IRE Canadian Convention. General Chairman for 1959 is E. L. Palin. Dates: October 7-9, 1959. Place: Automotive Building, Toronto

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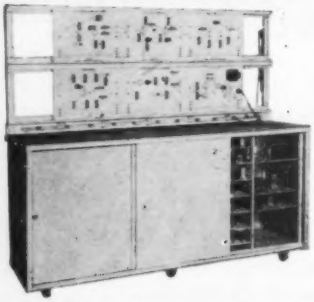

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IRE Canadian Convention

There is an axiom among business people which states that the most difficult period for any new business enterprise is the third year.

1958 looked pretty rough for the IRE Canadian Convention and Exposition. During the previous year the Canadian economy had been down, defense contracts had been held back pending election of a government with a working majority, and Prime Minister Diefenbaker had made his decision on the Arrow-Astra-Sparrow programs. This did not bode well for the third annual meeting of the Canadian electronics engineers.

Dr. George Sinclair, general chairman of the executive committee for 1958

"Things seem to be slower this year than last," said one exhibitor, "but we really don't expect to gain much through the show this year."

That was the attitude of many of the exhibitors on opening day. How wrong they were! By closing day the tune had changed. A few were still glum, but the majority were surprised —pleasantly surprised.

Typical of the comments from the exhibitors was the one made by Mr. A. Price, manager, Government and Industrial Dept., Philco Corporation of Canada. In an earlier interview (CEE, July 58, page 38) Mr. Price had been rather noncommittal about previous shows. This year, however, he told the CEE editors, "Never before have we had so many enquiries from people who are genuinely interested in the products on display at the booth. I think that there have been fewer engineers' calls at the booth this year, but those that have come did so because they had a definite problem to discuss. These are the people we want to meet."

The various committees of the IRE, as well as convention manager Grant Smedmor and his staff, have worked hard to produce a show that would be "better than ever," said

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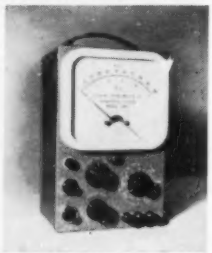

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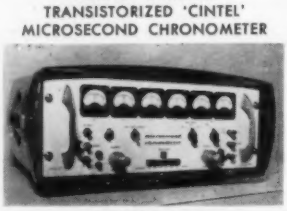

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P. A. Bagnell displays the latest line of Bomac microwave components

Dr. George Sinclair, general chairman. "The exhibits fully reflect this effort.

"This, plus the excellent technical program, justify the decision to make this Canada's largest annual scientific meeting," said Dr. Sinclair.

The border is permeable

Despite any political differences which may arise from either side of the U. S.-Canadian border, that border is permeable. It can be and is continually being pierced by the interchange of technical information between engineers and scientists of the two countries.

In his official opening address on Wednesday afternoon, Oct. 8, Donald G. Fink pursued this theme even further.

Claiming a form of "universal citizenship" by virtue of his position as president of the international IRE, Mr. Fink ventured a few comments on the current uncertainties about the future of Canada's military electronics procurement policy.

Atlas Instrument Corp. Ltd. had its Travelab at the show. F. Sargeant has been touring with it, demonstrating principals' range of instruments.

Stressing that an active defence electronics program does not only provide employment, but also the opportunity of perfecting technical developments and establishing a pool of professional "brainpower," he expressed his sincere hope that decisions would soon be made that would be healthy for both the Canadian electronics industry and the radio engineering profession in Canada.

"An industry that is not supported," said Mr. Fink, "will wither on the

(Continued on page 46)

TRANSISTORIZED HF RADIOTELEPHONE

25 Watts: 1.6 to 3.5 Mc

Contains a completely transistorized 20 watt modulator, DC inverter and high performance communications receiver. A similar unit is scheduled for quantity production under contract with the Canada Department of Transport.

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JANUARY 1959

In January, 1959, Canadian Electronics Engineering will publish its Annual REVIEW & FORECAST of Canada's electronic industry. Well-illustrated by photos, charts and tables—this will be a most comprehensive report on the industry, prepared in consultation with leading figures in the industry.

Reserve extra space to tell your full story.

Closing date is Dec. 18, 1958.

The displays at the show this year were more professional looking than in previous years and attracted much attention

Editor Harold Price checks latest F-R Machine Works microwave fittings with S. H. Ungar of Radionics Ltd.

The largest book in the show was at booth of Electronic Associates Ltd. They will publish Convention Record

Visitors Ames and Farmer from C. P. Clare took close look at the Texas Instruments' transistorized tv set

One feature of the IRE Convention is the quiet, serious, yet friendly atmosphere. This is the place where engineers come to see the latest developments. This group discussed communications at Automatic Electric booth

Education panel had a lively debate. L-R: A. S. Barber, A. Porter, W. F. McMullen and chairman G. R. Slemon

Exhibitors were pleased to receive a higher percentage of good sales enquiries this year than in previous years. The novelty to the show has worn off and engineers now come to discuss definite problems with the suppliers

Roy Smart of Helipot Corp. gives the story on their newest Canadian made product, a rectilinear potentiometer

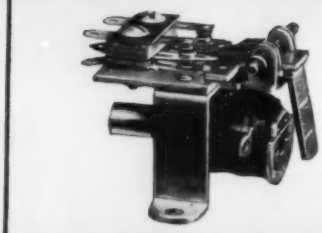
What marvel of the electronic age could be holding this large group of show visitors under its magical spell? None other than that great spell binder, the television receiver — in the dying moments of the world series

Dr. Soanes sets up the new Ferranti-Packard model 206 photoelectric tape reader. Reading rate is 200 char/sec

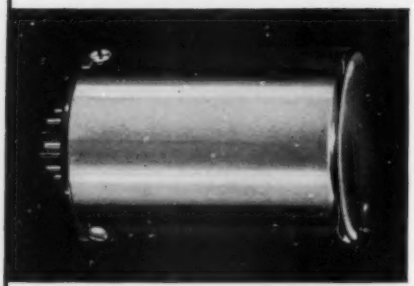
NOW AVAILABLE IN FOUR VERSATILE MODELS

SNAP-ACTION CONTACT speed gives positive actuation . . . up to double-pole, double-throw switching in standard models.
SIMPLE TIME ELEMENT, hermetically sealed, is not subject to aging or fatigue. Core design permits fast reset: 25% of relay operating time, even with longest delay periods!
MAGNETIC COIL is accurately calibrated, uses no heaters or thermal elements. Results: relay may be energized continuously. It's a load carrier in itself; does not require auxiliary lock-in circuits.

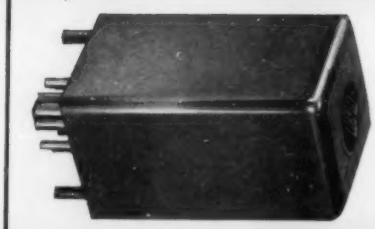
the proven *Silic-O-Netic* time-delay relay



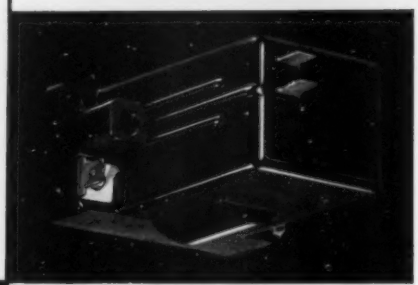
ECONOMICAL Type A Relay is non-enclosed, offers time delay from ¼ to 120 seconds. A low-cost relay with superior performance specifications.



PLUG-IN Type H Relay adds convenience of pin-type mounting, fits standard eight-hole sockets. Removable aluminum cover. Also made with solder-lug terminals.



HERMETICALLY-SEALED Type F Relay gives complete protection against dirt, dust and moisture. Hermetic seal is permanent . . . relay never requires adjustment. Choice of pin-type or solder-lug mounting.



PHENOLIC-ENCLOSED Type C is a low-cost, fully encased relay with D.P.D.T. switching capacity. Compact design allows easy mounting, is available with "quick-on" type contact and coil terminals.

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New Bulletin No. 5003 includes full details and specifications for Silic-O-Netic Relays. Write for a copy.

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D. Potter tries out the Topping Electronics Ltd. 25-watt radiotelephone. Operation is in 1.6 to 6.0 mc band

vine and the profession will wither with it."

Technical sessions were excellent

During the three days of the convention nearly 120 technical papers were delivered. Of these, over 100 were by Canadian authors.

Attendance at the technical sessions was very good again this year. At any one time an average of 390 engineers were listening to the authors delivering their papers.

The most popular session this year was Stereophonic Disc Recording and Audio. It drew a peak attendance of 190. Running a very close second was Transistor Circuit Design with 185. Held concurrently with the latter was the third largest session, Engineering Writing and Speech.

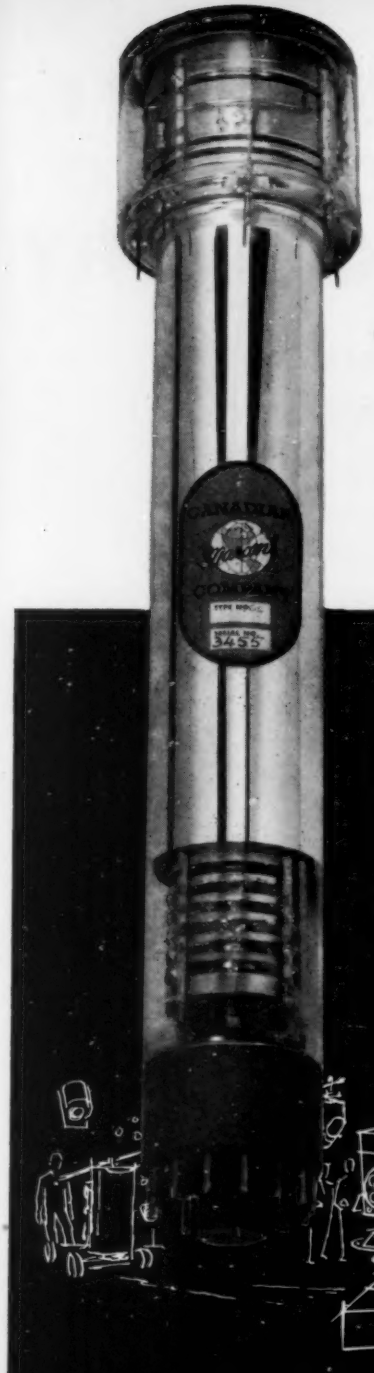
Greater interest was shown this year in the rôle played by electronics in the medical world. The session on Medical Electronics I had a peak attendance of 72, a marked increase over previous years.

Medical electronics drew more attention this year. A. Price shows Philco Exicon to FO W. D. Macnamara of RCAF Institute of Aviation Medicine

"We have found that the most successful sessions are those that have been planned as a unit right from the start, particularly when planned by one of the Professional Groups," said Frank Ford, a member of the Technical Program Committee.

"These have proven to be more successful than the sessions formed by gathering together some of the individual papers submitted for con-

(Continued on page 49)



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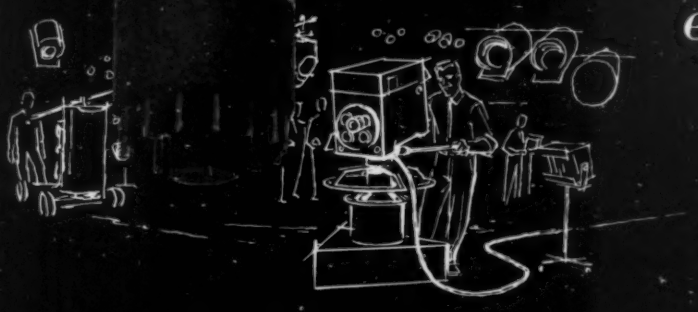

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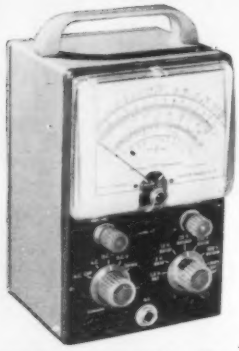

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sideration. Personally, I would like to see more sessions planned in this way," said Mr. Ford. "Conversely, I hope this kind of success will encourage the formation of more local chapters of the Professional Groups.

Dr. L. W. Billingsley of DRB gave some sound advice in his paper, "Write to inform, not to impress"

"Another encouraging feature of the technical sessions is the number of papers submitted each year for consideration. After the 1956 convention several people expressed doubt that there was enough engineering taking place in Canada to provide papers for a convention every year. Those same people, after the 1957 meeting, assured everyone that the supply of papers had definitely been exhausted. They were wrong," said Mr. Ford. "The surplus of papers this year was as large as ever. And we need to have a surplus every year if we are to assemble a first-rate technical program."

All the technical papers are being published in a Convention Record. This is the first time for such a publication to be produced by the IRE Canadian Convention, and it is being undertaken in response to numerous requests to preserve the papers in permanent form. Copies may be ordered from the IRE Canadian Convention, 1819 Yonge St., Toronto 7, Ontario. Price is $5.00 per copy.

Slaves, robots or radio engineers?

Banquet speaker Lt.-Col. Kurt R. Swinton scored the lack of "guided thinking" in his stirring speech at the Royal York Hotel. These are excerpts from his speech:

"Tracing the world's scientific and sociological progress through the childish optimism of the 19th century with its acceptance of a purely mechanical model of the universe, to the present day, we find the major event of the last 100 years to be Henry Ford's introduction of the principle of mass production. If the 19th century saw the death of God, then the 20th may well see the death of man as an individual."

"Man is puzzled nowadays when he seeks for the symbol of authority. When even the authority of the church is questioned, man finds himself led by an amorphous, anonymous authority, largely represented by the term 'conformity.' Radio engineers have contributed to this situation by making mass media available—seventy million people saw President Eisenhower explain the latest trip to the brink."

"Society as a whole must come to the aid of the individual, finding ways to identify him as a unique person and to place him alongside his fellow men that will not inhibit or destroy his individuality. By its educational system, its public and private institutional practices, and, perhaps more importantly, by its attitude toward the creative person, a free society can ensure its constant invigoration and regeneration."

Exhibit award

A new feature at the 1958 IRE Canadian Convention was the Exhibit Award. This was an honor awarded to the best Canadian-designed equipment submitted by any exhibitor.

The award this year went to Mr. R. Wilton, Bach-Simpson Ltd., London, Ontario. His prize-winning design is the model 2610 wide band

H. Ross Smyth, centre, chairman of the Exhibit Award committee discusses award with recipient R. Wilton, left, and J. S. Bach of Bach-Simpson, Ltd.

laboratory oscilloscope. This is a medium priced cro which includes a slide-back amplitude measurement system with a built-in meter and a novel calibration arrangement.

A full description of the Bach-Simpson model 2610 oscilloscope was published in the February 1958 issue of CEE.

Student delegates

As in previous years, a representative from each of the IRE Student Branches came to Toronto as a guest of the IRE Canadian Convention. At-

IRE students (l-r) Delesle, Long, Cherrington, Japling, Reed, Kupin and Schrack talk with E. L. Palin, general chairman, 1959 convention

tending this year were Jules Delesle, Laval University; Robert Long, Ryerson Institute of Technology, Toronto; Blake Cherrington, University of Toronto; Gary Japling, Institute of Technology and Art, Calgary; Norman Reed, University of Saskatchewan; Peter Kupin, University of Alberta; Fred G. Schrack, University of British Columbia. Upon their return to their schools they were to make full reports to their fellow student members of all that they learned at the convention.

While there were many new and interesting new products and developments to be seen at the show it would take more space than is available here to describe them. A few have been shown in the accompanying illustrations, but it must be pointed out that these were a few random samplings only.

Next Year

In a year when the industry was a bit depressed it has staged its strongest show. This indicates that industry has lost some of its surplus fat and is now getting down to work in earnest. The future still is not too secure for some, but we expect to see a good turnout at the 1959 IRE Canadian Convention. Plans already are under way to make this another milestone in the history of the Institute of Radio Engineers, Region 8.

The new General Chairman of the executive committee is E. L. Palin. He isn't waiting until next year to get things rolling. Some of his new plans were under way the day after his election.

It will be an important convention in 1959, and CEE will be there. END

Ahhhhh!!!

For your library

Basic electricity for students entering electronics

Basic Electricity for Communications Second Edition

William H. Timbie. Revised by Francis J. Ricker; John Wiley & Sons, Inc. New York; 538 pp; $6.25.

This text has been designed to provide the student entering electronics with a sound knowledge of the basic principles of electricity. Chapter one discusses molecules, atoms, electrons and protons, electric charges and some concepts of currents and conductors. From there the text progresses to the fundamentals of Ohm's Law, electric power and energy, electric conductors, measurement of resistant, Kirchhoff's Laws, Thevenin's Theorum? batteries, magnets and magnet circuits, generators and motors, inductance, capacitance and alternating currents. The final chapters deal with vacuum tubes, gaseous conduction and semi-conductor devices.

Designed as an introduction to the subject of communications, the text is written so that the student is required to use only algebra and trigonometry. Most of the text is written in a descriptive manner.

Problems and examples are used profusely throughout the book. This should make it extremely valuable for teaching purposes. Thirty four pages have been devoted to the appendices. Here will be found useful tables on temperature co-efficients, resistance of copper wire, trigonometric functions, common logarithms, resistor color codes, etc. Included is a brief description on how to solve alternating current problems using the J-operator.

Automatic Process Control

Donald P. Eckman. John Wiley & Sons, Inc., New York; 368 pp; $9.

Reviewed by E. Leaver, Electronics Associates Ltd., Willowdale, Ontario.

Automatic Process Control by Professor Donald Eckman of Case Institute of Technology, is designed to be used as a text book. Familiarity with hydraulics and calculus, including the La Place Transformation, are prerequisites for the study of this book. The chapter headings are: The Science of Automatic Control, Process Characteristics, Controller Characteristics, Closed Loop in Automatic Control Measuring (Feedback) Elements, Controlling Elements, Final Control Elements, Process Instrumentation, Sinusoidal Analysis, Stability Analysis and Appendix. I include the latter as a chapter because of the nature of its contents (34 pages). These comprise Automatic Control definitions, a short dissertation on Differential Analyzers, and descriptions of nine experiments ranging from process time constant to control valve characteristics. Questions and answers are provided at the end of each chapter.

On the whole, I think this is a useful book in the restricted area of automatic process control.

While the explanations are good, they are somewhat marred by, what in my opinion, is a rather careless use of symbols. Symbols are, of course, arbitrary, and hence, 'u' may be used for pressure or rate of flow, or anything else for that matter, but it becomes more difficult to follow a text if a symbol is used for one variable or parameter on one page and for another on the next. The use of the same symbol such as 'T' for both characteristic time and time constant is not an aid to study either. The practice of setting up a list of symbols at the front of the book could have been profitably employed here.

The matter of signs seems to have been handled a little loosely in some of the equations. While this is not a serious matter, it makes study a little more difficult.

The first chapter mentions 'information' in a short paragraph and then completely ignores the concept as such throughout the next 359 pages. This is a common characteristic of books on automatic control.

Some day a book will be written in which the concept of information is the central theme. As automatic control is chiefly an informational procedure, such treatment will bring new insight into this increasingly complex and important subject.

Automatic Process Control isn't that kind of book, but it is a timely, competent and useful text.

The Proceedings of the Second International Conference on the Peaceful Uses of Atomic Energy.

Because of the rapid development in the science of atomic energy for peaceful uses in the last three years, the United Nations convened the Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, Sept. 1-13. The full proceedings are being published in 34 volumes and are available at a pre-publication price of $435.00 (U. S. A.) if ordered before November 30, 1958.

The first volume will be available December 1958, and the final volumes are expected off the presses by July, 1959.

Individual volumes will be available but details have not been announced yet.

Orders should be sent to: United Nations, Sales and Circulation (Atomic Energy) New York, N.Y.

Catalogues and brochures from the manufacturers

Industrial tube flip-chart provides 30 pages of electrical and physical characteristics for Tung-Sol industrial tubes. Abbey Electronics Ltd., Downsview. (101)

Standards of the Expansion Joint Manufacturers Association. Contains information on the design, construction, application and testing of expansion joints for piping and other services. Price $1 (U. S. A.). Expansion Joint Manuf. Assoc., New York, N.Y. (102)

How to build a transistorized audio power amplifier, power control, battery charger, regulated power supply, electronic organ, geiger counter and other circuits. Six-page folder gives circuits and instructions. Motorola Inc., Phoenix, Arizona. (103)

Geiger and scintillation detectors and the associated electronic equipment are described in a 67-page brochure. Philips Electronics Industries Ltd., Toronto. (104)

Thermistors: rods, discs, beads, washers and assemblies are presented, along with typical circuits in 16-page brochure EMC-2. Fenwal Electronics Inc., Framingham, Mass. (105)

MS miniature connectors type KM meet specification MIL-C-25955. Full descriptions are in 10-page catalogue KM-1. Cannon Electric Canada Ltd., Toronto. (106)

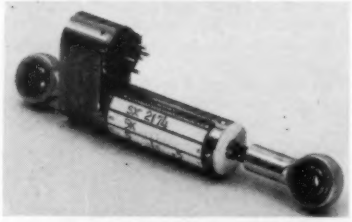
Oz. In. torque versus rpm chart. Engineering data given ranges from 1/2,000 hp to 1/3 hp and from 1 to 14,000 rpm. John Oster Mfg. Co., Racine, Wisconsin. (107)

Rectilinear potentiometer measures linear motion directly

Precision wire-wound rectilinear potentiometers for applications such as measuring variations in position of control surfaces on missiles or aircraft, gauging liquid levels, sensing strain, are now offered by Helipot of Toronto.

Transducers of this type measure linear motion directly, bypassing gear trains and other devices necessary for translating linear motion directly to rotary motion.

Helipot's standard model is a high-temperature unit for operation at ambients from —55 deg C to 125 deg C. Linearity, resistance range and power dissipation (½ watt per inch) are dependent on length of resistance element, which is set by system requirements.



R-O-R Associates Ltd., Don Mills, Ontario. (120)

Electrical grade silicone fluids

Electrical grade silicone fluids series SF-97 have been designed for use in capacitors, pulse transformers, specialty transformers, airborne and land based radar equipment, and in television circuit components. They are especially suited for applications requiring fluids with good heat transfer qualities and where reliable operation is required under severe operating conditions.

These silicone fluids are available in viscosities of 50, 100 and 1,000 centistokes. Minimum dielectric strength is 32.5 kv; dissipation factor is 0.0001 at 100 and 100,000 cps (25C); dielectric constant is 2.75 ± 0.05 at 100 and 100,000 cps (25C); volume resistivity is 1×10^{14} ohm-cm.

Canadian General Electric Co. Ltd., Toronto. (121)

Relay has encapsulated coil

To provide the protection necessary for efficient operation in corrosive, deteriorative atmospheres, Philips Electronics Industries has announced the development of a fully-encapsulated coil for use with their line of Ebert relays. In addition to the utilization of moisture-resistant, vacuum impregnated, cotton interweave coils employed in all Ebert Relays, their encapsulation in approved polyester resin compound offers additional protection where the rigors of harmful atmospheric conditions are exceptional. This often does away with the need for bulky, expensive housings. Since all Ebert relays incorporate hermetically sealed mercury-to-mercury contacts, protection against environment is also afforded to the relay mechanism.

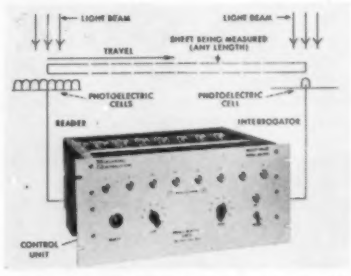
Philips Electronics Industries Ltd., Toronto. (122)

Gauge checks sheet miscuts

A new control device for automatically measuring the length of steel sheets moving along a conveyor belt at up to 50,000 feet per minute and rejecting short or long sheets has been developed by Eldorado Electronics of Berkeley, California.

Although the first unit was purchased by a steel mill, the device is equally well adapted to nonferrous metal, plastic, paper, rubber, textile or other material fabrication processes where accurate dimensional control is desired.

In operation, a bank of reader photocells and an interrogator photocell are positioned along a conveyor belt so that the leading edge of the sheet crosses interrogator position at the same instant as the trailing edge is positioned over the centre of the reader bank. Breaking the interrogator light beam energizes the reader bank of photocells. For every cell covered by the steel sheet, a corresponding panel light glows. Since the photocells in the reader bank are spaced on 1/32-in. centres, each pilot lamp on the control panel represents a 1/32-in. increment of length. Accuracy of the system is ±0.003 in. which is completely independent of the speed of the conveyor line. When an out of tolerance sheet is measured, the control unit produces an output signal to actuate an alarm and operate an automatic reject system taking the sheet off the line. The miscut gauge is rated for continuous operation.



Eldorado Electronics, Berkeley, Calif. (123)

250° arc angle meters

The Stark 250° arc angle meters, with accuracies up to 1%, are specifically designed to save panel space. A 3½-in, 250° meter has the scale length and readability of a conventional 6-in. meter. They can be supplied in all dc ranges and ac rectifier types. They are manufactured in conventional panel, aircraft, sealed or ruggedized cases in sizes 2½ in. to 5½ in.

Stark Electronic Instruments Ltd., Ajax, Ont. (124)

Miniature variable resistor

This variable composition resistor, developed and manufactured in Canada, is available in type T with bushing mount

and type V for standard 0.100 printed circuit layout (lugs spaced .200 in.). The outside diameter is only ⅜ in., and the resistors can be used under extreme environmental conditions as specified in MIL-R-94B.

Precision Electronic Components (1956) Ltd., Toronto. (125)

Gearheads for standard servo motors

Precision spur gearheads for Standard Bu-Ord Servo-Motor Sizes 11 and 15 are available with ratios up to 20,000:1. In the low ratio series up to 37:1, two over-all lengths are offered; .500 in. for a torque rating of 25 oz. in. and .609 in. for a torque rating of 50 oz. in. The maximum backlash is 15 minutes. All "U. S. Spur GEARheads" in the high ratio series from 37:1 up to 20,000:1 have a torque rating of 50 oz. in. and a maximum backlash of 30 minutes. A feature of these units is the minimum length in relation to the reduction ratios as follows for the Size 11 Unit: .689 in. for 37-110:1, .810 in. for 110-370:1, 1,000 in. for 37-1200:1 and 1.250 in. for 1,200-4,000:1. The size 15 unit will give correspondingly higher ratios for the same lengths up to 20,000:1 for 1.250 in. General specifications include stainless steel shafts, anodized aluminum housing, gears to AGMA Precision 2, ball bearings to ABEC-5 with radial clearance .0002 in. to .0004 in. "U. S. GEARheads" will operate in an ambient temperature range from minus 55F to plus 260F and are guaranteed for 2,000 hours operating life.

Hudson Randall International, Scarborough, Ont. (126)

Cordless table radio

Canadian Admiral Corp. Ltd. has introduced a cordless table radio using transistors. The new radio will play up to 1,000 hours (one full year) on six "C" type flashlight cells. It features variable tone control, automatic volume "sentinel" and a built-in antenna in a high-impact plastic cabinet. Eight transistors and a germanium diode are utilized in the new sets.

Canadian Admiral Corp. Ltd., Port Credit, Ont. (127)

(Continued on page 52)

Data processing system is fully transistorized

A fully transistorized data processing system has been developed by IBM to fill the gap between large-scale systems such as the IBM 705 and medium-range computers such as the IBM 650. The new machine is known as the IBM 7070.

The new system is based on a modular design. A user may start his system with high-speed punched card input and output and build to multiple tape and disc file operation, as his needs expand. By using two channels, the 7070 is able, while computing, to read or write magnetic tapes at the rate of up to 125,000 characters per second. Also, it can handle simultaneously, several new high-speed 400-card-per-minute readers and 250-card-per-minute punches.

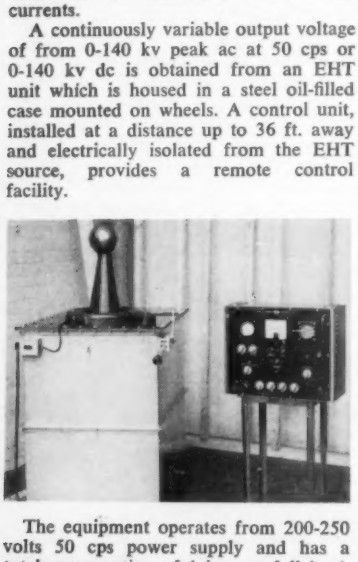
To increase flexibility and permit in-line data processing, four files of 50 magnetic discs can be included in the system, providing for the random access storage of 24 million digits, any one of which can be located and altered quickly. Coupled with this is an immediate access memory of 50,000 to 100,000 digits held in ferrite cores.

International Business Machines, Toronto. (128)

Flash tester operates up to 140 kv.

Airmec 100 kv flash tester type P.200 has been designed for ac and dc testing of insulating materials and component dielectric at very high voltages. It not only provides a heavy current for breakdown but also incorporates a sensitive indication of ionization and leakage currents.

A continuously variable output voltage of from 0-140 kv peak ac at 50 cps or 0-140 kv dc is obtained from an EHT unit which is housed in a steel oil-filled case mounted on wheels. A control unit, installed at a distance up to 36 ft. away and electrically isolated from the EHT source, provides a remote control facility.



The equipment operates from 200-250 volts 50 cps power supply and has a total consumption of 1 kva on full load.

Radio Communications Equipment & Engineering Ltd., Montreal. (129)

Continuous writing streak camera

A research tool for the photo-instrumentation study of self-luminous transient events, the new Model 194 Beckman & Whitley Continuous-Writing Streak Camera produces a documentation which is a plot of space in one direction versus time in a 90-degree direction.

Primary applications will be in the study of explosions, shock-tube manifestations, and flash-tube and spark-discharge phenomena. Because of the continuous-writing feature, the requirement of synchronizing the camera and the event is eliminated, greatly simplifying use.

The new instrument mounts on its own base and control housing. Standard 35-mm film, arranged for daylight loading and unloading, is used. The image is swept onto this film by a rotating triangular mirror driven by a high-speed turbine. Several types of these drives are available—the fastest one, ranging from 200 to 5500 revolutions per second, is driven by helium gas.

This arrangement produces a maximum writing rate of approximately 8 millimeters per microsecond; a total writing time at top speed of 58 microseconds; and a maximum time resolution, using a 0.004-in. wide slit image and film having a resolution of 75 lines per millimeter, of 2.5 x 10-8.

Beckman & Whitley, Inc., San Carlos, Calif. (130)

Medium power transistors

These new transistors have been designed for medium power amplifier and low frequency, high current switching applications.

The four models available in this line have received JETEC designations 2N524, 2N525, 2N526 and 2N527. They have a triangular lead arrangement and are housed in the JETEC TO-5 package.

The 2N525 and 2N524 types are the electrical equivalents of the 2N43 and 2N44 transistors respectively and in most circuits may be substituted directly.

The transistors feature a high degree of beta and I_{co} stability with life. 4,000-hour life test data for typical units show that beta varies less than 10% and I_{co} changes less than 20% at a 100C storage temperature.

With a collector current of 20 milliamperes and a voltage of 1 volt in a common emitter circuit the 2N524 has a typical forward current gain of 35, and the 2N525 has a gain of 52, the 2N526 has a gain of 73 and the 2N527 exhibits a current gain of 91.

Beta holdup on all models is typically 75% of the 20-milliampere value at 200 milliamperes.

Typical alpha cutoff frequency is 2.0, 2.5, 3.0 and 3.3 megacycles respectively.

Typical beta cutoff frequencies are 80, 70, 60 and 50 kilocycles respectively. Beta cutoffs of this level are higher than normally found in transistors with a common emitter working voltage of 30 volts.

The new transistors are capable of 225 milliwatts dissipation in free air at 25C and one-half watt with an infinite heat sink.

They may be operated up to a temperature of 85C and may be stored at 100C.

Canadian General Electric Co. Ltd., Toronto. (131)

Metal-clad battery

A leakproof, metal-clad battery is the latest battery line to be introduced by a new Canadian company. The Mallory M-13 battery incorporates the following features: 1. Chrome steel metal-clad design, 2. New construction using paper separator, polyethylene retainer cap and a patented sealing technique, 3. High amperage which is important for portable powered devices.

Mallory Battery Co. of Canada Ltd., Toronto. (132)

Magnetic frequency detector

Model 510 Cyclemag magnetic frequency detector measures audio frequencies directly, using only static components. It delivers 0-500 μa of DC output for 0-500 cps input. Accuracy is better than 1%, despite large changes in driving voltage and in driving waveforms. External power sources are not required as the detector uses the signal source as its sole source of energy.

The new detector is hermetically sealed and ruggedized in a convenient plug-in package. It withstands more than 100 G's of shock and will operate for long periods without maintenance or adjustment.

Acromag, Inc., Detroit. (133)

Interchangeable meter dial component

The Triplett Unimeter affords a new way to have a variety of panel meters at low cost combining any number of Dial Component sections with a separate Basic Movement Section.

Since the basic movement accounts for

the greater part of the meter cost, this new development permits a much more flexible inventory by stocking the minimum number of basic meter movements and a maximum quantity of varied inexpensive Dial-Components.

The assembly process requires only a matter of five to six seconds. Simply slide the two sections together, and lock with a thumb screw on the back.

The Triplett Electrical Instrument Co., Bluffton, Ohio. (134)

TV-stereo phonograph combination

Development of the 110-degree picture tube has made it practical to combine television and phonograph sets without resorting to a cabinet that would be too large for the average living room of today. Canadian Admiral has, accordingly, introduced its "Dual channel stereophonic theatre" which combines television with a stereophonic phonograph in one cabinet. The dual channel stereophonic amplifier gives 5 watts output on TV and 10 watts output on phonograph.

Canadian Admiral Corp., Ltd., Port Credit, Ont. (135)

Rectangular tubing with sharp corners

Rectangular stainless steel tubing with extremely sharp corners and close dimensional tolerances has been developed by Superior Tube Co. for use as waveguide.

Tolerances of inner dimensions are held to within 0.002 in. on some sizes. The sharp radii, down to 1/64 in. in the smaller sizes, permit critical waveguide dimensions to be held right into the corners for the rectangular tubing.

Made from non-magnetic AISI type 304 stainless steel, the tubing is now being used by several industrial and university laboratories for microwave paramagnetic resonance experiments at high and low temperatures. These experiments are used to determine crystal structure of solids, molecule structure and inter-atomic forces. In addition, stainless steel waveguide tubing has potential application in radar installations where its excellent corrosion-resisting properties are advantageous, such as in marine atmospheres.

Superior produces the stainless steel waveguide with inside dimensions from .122 x .061 in. to 1.872 x .872 in. Wall thicknesses are from .010 to .025 in.

Superior Tube Co., Norristown, Pa. (136)

High temperature rectifier

High temperature silicon rectifier type TM155 offers 1,500-volt, 400-ma ratings at 150C case temperature. Developed by Transitron Electronic Corp., this device may be used in high-voltage power supplies for magnetrons, klystrons, electronic precipitators and other applications requiring 600-volt output or higher. The unit is hermetically sealed in the standard 7/16-in. hex package, and is resistant to shock, vibration and environmental changes.

Adams Engineering Ltd., Montreal. (137)

Ionization gauge with choice of filaments

A new flanged all-metal Bayard-Alpert type ionization gauge with non-burnout iridium filament (FG-200), or double tungsten filament (FG-200-T) is now available. These gauges are for use with all-metal and bakeout vacuum systems.

The Veeco type "FG" gauge may be used both in the high vacuum region (1 micron and less) and in the ultra-high vacuum region below 10^{-8} mm Hg.

Non-burnout thoria-coated iridium is used as the filament in the type FG-200 gauge. Iridium does not oxidize, so that the gauge is immune to the destructive effects of air. There is no danger of filament burnout at inopportune moments due to accidental exposure to air. The double tungsten filament gauge, type FG-200-T, is provided for application where accidental exposure to air is unlikely, or where special atmospheres limit the use of thoria-iridium.

The helical molybdenum grid is outgassed by passing a current of approximately 10 amperes through it. This will at the same time outgas the collector wire by radiation.

Veeco Vacuum Corp., New Hyde Park, L.I., N.Y. (138)

Compact 15-turn precision potentiometer

Maximum resolution in a minimum space is one of the features offered by the new Helipot series SZ1500 precision potentiometers. Standard resistance ranges are from 75 to 600,000 ohms with linearity tolerance of ±0.3%. Linearities as close as ±0.025% are available.

Standard resistance tolerance is ±3% with ±1% available. The power rating is 7.5 watts at 40 C, derating to zero at 85 C. Maximum applied voltage is 1,000 volts dc. Dimensions of the 15-turn potentiometers are: diameter 1-13/16 in.; length 2⅝ in. Weight is 5.7 oz.

R-O-R Associates Ltd., Don Mills, Ontario. (139)

Case and rack construction system

The MEL-Imlock system can be applied to any design of case or rack except circular shapes. This system consists of two basic components — extrusions with grooves into which sheet metal panels are fitted, and corner castings which act as connectors. Panels desired to be removable are fastened to the extrusions with panel screws. A number of MEL-Imlock accessories such as specially designed hinges, handles and locks are also available.

Measurement Engineering Ltd., Arnprior, Ont. (140)

DC to 30 mc fast rise oscilloscope

The Tektronix Type 543 is a fast-rise oscilloscope with plug-in feature. Nine plug-in preamplifiers are available for signal-handling versatility. Sweep range is 0.02 mu sec/cm to 15 sec/cm, accelerating potential is 10 kv, built-in voltage calibrator has 18 outputs from 0.2 mv to 100 v peak-to-peak.

New features for a dc-to-30 mc oscilloscope are: Sweep magnifications of 2, 5, 10, 20, 50 and 100 times; single-knob control of 24 direct-reading calibrated sweep rates; improved triggering with preset controls; lockout-reset circuitry for single-sweep recording; new frame-grid dual-triodes for greater dependability.

Tektronix Inc., Willowdale, Ont. (141)

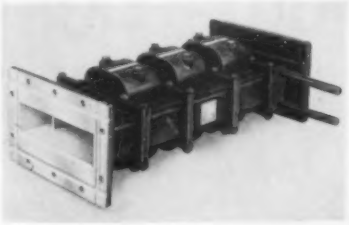
Subminiature switch

Haydon subminiature switch type 5366 is qualified to MS25085 with operation up to a temperature of 400 F and a rated load of 5 amps resistive and 3 amps inductive. Mechanical life of 1,000,000 cycles, and 100,000 operations under rated load, are some of its features. The switch has been designed for the aircraft and missile industries.

Philips Electronic Industries Ltd., Toronto. (142)

L-band ferrite isolator

An improved version of Raytheon's high-power L-band microwave ferrite



isolator has just been introduced.

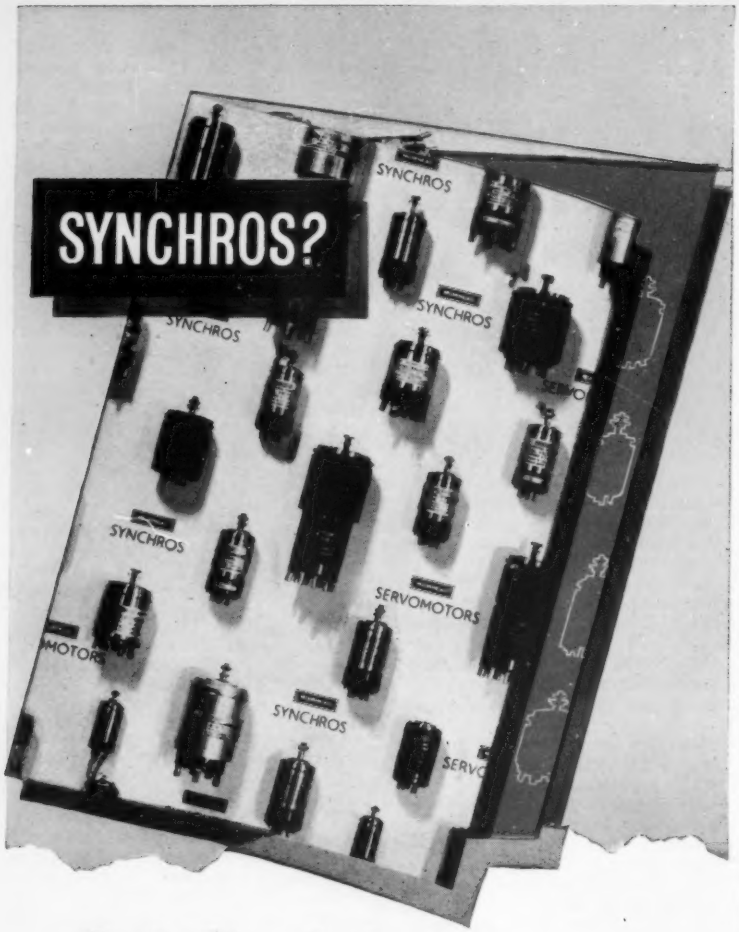
The new unit, Model 1LH2, is constructed of half-height waveguide to reduce size and weight. It is 6 in. high, 8-11/16 in. wide, 17 in. long, and weighs 34 lb.

Built-in transitions to full-height guide provide match over the entire band so as to combine high performance with high power capacity. A cooling structure is available for use at higher power levels.

Minimum transmit/receive isolation is 11 db; maximum insertion loss is 0.55 db. Average power handling capacity is 2½ kw, peak power is 3 megawatts.

Raytheon Canada Ltd., Waterloo, Ont. (143)

(Continued on page 54)



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Muirhead TECHNIQUE, a quarterly journal for all designers, regularly contains news of additions to the Synchro range.

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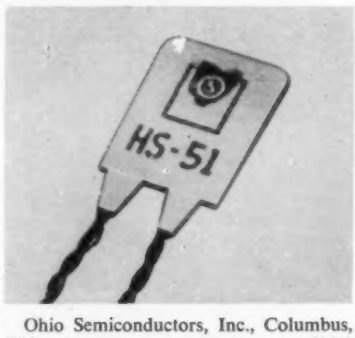
New products—cont.

Devices use Hall effect

Halltron is a name given to a new series of intermetallic compound semiconductor devices. They are being fabricated from a wide range of specially purified and chemically controlled compounds of indium - antimonide and indium-arsenide. The wide range of compounds permits a broad range of controlled device characteristics. Halltron is derived from the fact that the device operates as a function of the Hall effect — i.e., the effect of a magnetic field upon electron current flow in a direction perpendicular to the magnetic field. The output of the device is a voltage function of the product of the input magnetic field and control current.

The first device in the series, Halltron type HS-51 is now available. An example of its performance is as follows: for inputs of 500 milliamps control current and 10 kilogauss magnetic field (at normal room temperature ambient and no device cooling), the output voltage exceeds 500 millivolts. At zero field, the input impedance is 0.8 ohms, and at 10 kilogauss, the output impedance is 2.5 ohms. The wafer is ⅝ in. x ½ in. by 0.030 in. Substantially higher power levels and extremely low input and output signal levels can be accommodated at normal environments. Cooling extends both ranges to a great degree. Frequency response is in the order of 10^{-10} to 10^{-12} seconds.



Ohio Semiconductors, Inc., Columbus, Ohio. (144)

Siren works through mobile amplifier

This transistorized 20-watt audio amplifier has been designed for multi-purpose public safety applications. It may be used as a public address system and may be applied as a monitor with mobile radio systems to amplify messages for operators who have to leave their cars. The unit also is designed for siren operation purposes. The siren, supplied as optional equipment, will fit inside the audio amplifier case.

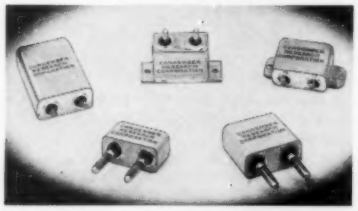
In an electronic siren application the equipment uses only 5 amperes at 12 volts. To facilitate its operation for mul-

tiple purposes, the unit is provided with a 3-position switch. This makes possible: (1) normal operation of the mobile radio, (2) monitoring of the mobile radio over an externally mounted horn, and (3) use of the equipment for public address messages which may be transmitted from the car without going over the air.

Canadian General Electric Co. Ltd., Toronto. (145)

Bathtub precision capacitors

A new line of bathtub-style, precision capacitors features a variety of terminals and optional mountings that will mean extra freedom for designers. Terminals may be single or multi-capacitance. They may also be on the front, top, bottom, or side, and may be plug-in or solder-lug type. Special mountings can be furnished where needed.



The new line is avalable in Mylar, metalized Mylar, Teflon, Polystyrene, paper, and metalized paper, in a wide range of capacities. They were engineered for use with filters, pulse-forming circuits, differentiating circuits, standards, servo-mechanisms, and integrating circuits.

Condenser Research Corp., Seymour, Indiana. (146)

Miniature rheostat

Model E rheostat is capable of 12½ watts dissipation at 40 C, yet this ceramic and metal component measures only ⅞ in. diameter, and extends 11/16 in. behind the mounting panel. Twenty-three different resistance values with linear winding are stocked, but rheostats with non-linear taper, tendem rheostats, or other features can be provided.

Ohmite Manufacturing Co., Skokie, Ill. (147)

Electromagnetic set coupler

Multiple sets can be operated from one fm or TV antenna and easily connected to the feed line with the Wizard 300 coupler. It clamps onto the feed line and contains two coupling elements to provide electromagnetic coupling. It has built-in frequency compensating characteristics so that the higher frequencies are attenuated less than the lower frequencies. All sets in the system receive approximately the same amount of signal.

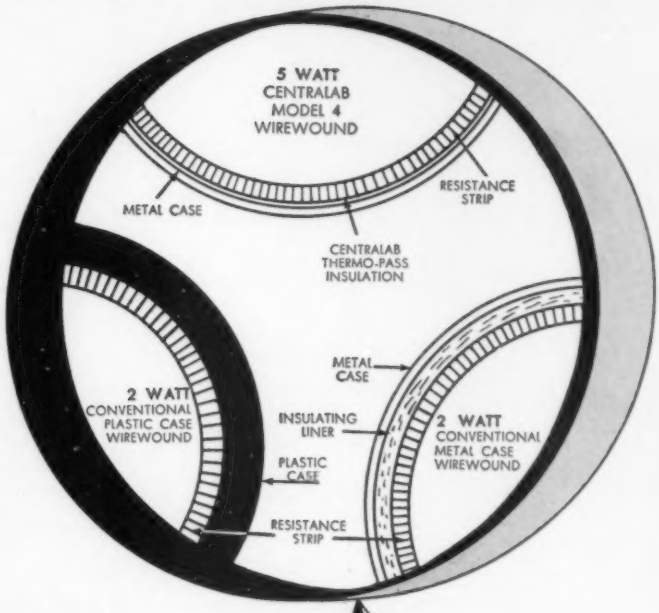
J. J. Macquarrie, Toronto. (148)

RADIO AND ELECTRONIC ENGINEER at present working in senior position for manufacturer in Britain, seeks employment in Canada. Age 45, long and varied experience. Also skilled in photography and music. Box 15, Canadian Electronics Engineering, 481 University Ave., Toronto, Ont.

5 watt capacity – 2 watt size

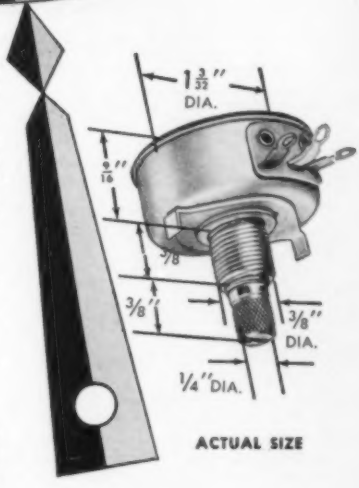
Centralab MODEL 4

Miniature Wirewound Radiohms®



As you know, the rating and size of a variable resistor depends upon the speed with which heat can be transferred from the resistance element to the atmosphere. Centralab "thermo-pass" insulation combines exceptional heat transfer with a dielectric strength of 4500 volts per mil at 25° C. Result: Model 4 Radiohm, a conservatively rated 5 watt wirewound variable resistor smaller than a conventional 2 watt unit.

- Only 1 3/32" diameter by 5/16" deep.
- Resistance range, 1 ohm to 15K ohms; linear taper.
- 295° rotation, stop strength 15 inch pounds.
- Minimum life, 25,000 complete cycles.
- Totally enclosed elements.



For detailed information write for Centralab Engineering Bulletin EP-493 or contact your Centralab sales representative. Ask your local distributor about the many values he carries in stock in the WW and WN series (listed in Catalog 30).

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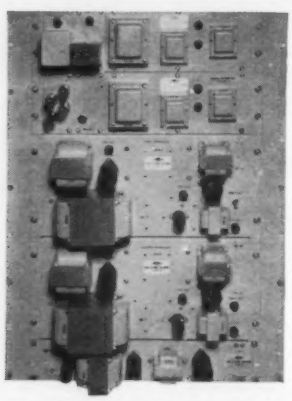
TRANSISTOR
POWER EQUIPMENT

Canadian "Know-how" Marks Up Another* First In Applied Electronics

Transistor power equipment offers a great step forward to the communications power field, with advantages in reduced maintenance, increased reliability, improved flexibility, and higher efficiency. Shown below is the PYLON Power Assembly Model 206, now in service with a number of major Canadian telephone companies.



PYLON Power Assembly Model 206

SPECIFICATIONS

INPUT: 48V D.C.

OUTPUTS:
1. 130V D.C. plate battery supply at 1 amp, ripple less than 50 mV.
2. 24V D.C. signalling battery supply at 5 amps, ripple less than 100 mV.
3. 24V D.C. talking battery supply at 1 amp, ripple less than 12 mV.
4. 75-105V A.C. ringing current supply, 20 c/s at 20 watts keyed 2 seconds "ON", 4 seconds "OFF".
5. 1000 c/s A.C. signalling tone, adjustable to 0 dbm.

Full standby is included on outputs 1-4 with built-in transfer facilities. This equipment incorporates the PYLON Power Module and the sensational new PYLON "Autoverter" . . . the high efficiency D.C. to D.C. converter without rectifying elements.

***Other PYLON firsts in transistor power equipment:**

1. First transistor ringing current generator.
2. First transistor equipment for 48V D.C. input.
3. First transistor equipment for 130V D.C. input.
4. First successful circuitry for load sharing amongst parallel transistors.
5. First (and still sole) supplier of high-capacity transistor power equipment.
6. First (and still sole) successful circuitry for fusing power transistors.
7. First (and still sole) user of the "TRANSISTOR POWER MODULE" concept.
8. First practical circuitry for D.C. to D.C. conversion without rectifying elements . . . the new exclusive high-efficiency PYLON "Autoverter".

ALL PYLON TRANSISTOR EQUIPMENT CARRIES A FULL ONE-YEAR WARRANTY

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SALES ENGINEER

Muirhead Instruments Ltd. of Stratford, Ont., have a vacancy on their sales staff for an engineer to sell their range of Electronic and Electro-Mechanical Instruments.

Applicants must be between 25 and 35 years of age and have a good electrical engineering background and an aptitude for this type of work.

The position is salaried and has excellent prospects for advancement. A car will be provided and an expense allowance will be made.

Applications should be made in writing to the Chief Sales Engineer giving full details of age, qualifications, experience and salary required.

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MICROWAVE ENGINEER

Excellent opportunity for a graduate engineer, or applicant with equivalent training, between 25 and 35 years of age, who is seeking promotion and greater responsibility in the communications field. Experience in the application of microwave systems in the telephone plant is essential.

Employment would be in Toronto with a well established and expanding firm. Employee benefits, pension plan, etc.

Apply in writing stating education, experience and age, to:

General Manager,
Automatic Electric Sales (Canada) Limited,
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Toronto 16, Ontario.

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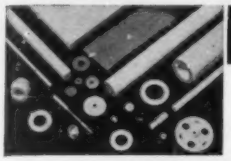

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for improved product design

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- **Wide Range of Stock Sizes—easily machinable for component parts**

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...**TEFLON***—rod, tubing, spaghetti tubing, tape, sheet, thin wall tubing

...**NYLAFLOW®** Flexible Nylon Pressure Tubing —up to 2500 P.S.I., for pneumatic, gas and liquid lines

...**Q-200.5** Cross-Linked Polystyrene— rod and plate

...**K-51** Chlorinated Polyether—rod, tubular bar, strip

...**NYLATRON® GS** Nylon Molding Powders

...**NYLASINT®** Finely Divided Nylon Powders for cold pressing and sintering

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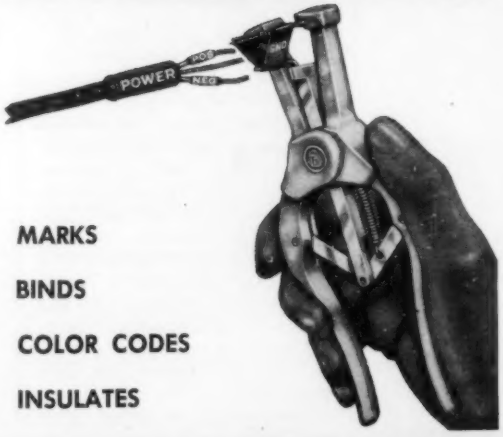

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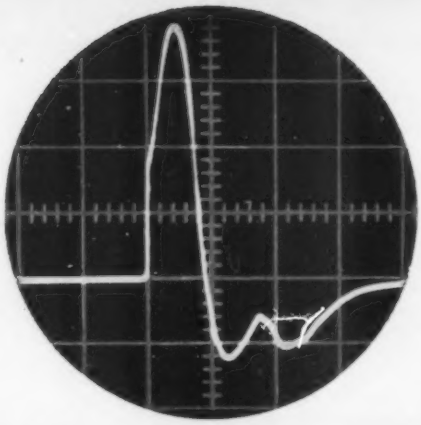

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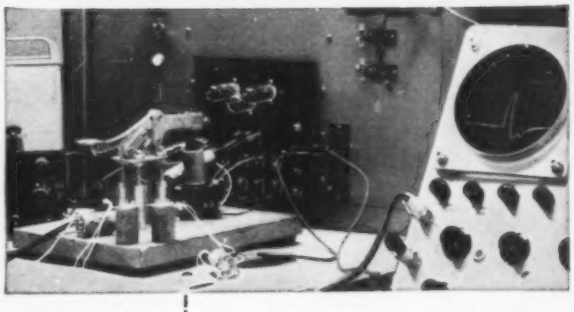
PULSE TRANSFORMERS



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H/10 **GUELPH ONTARIO CANADA**

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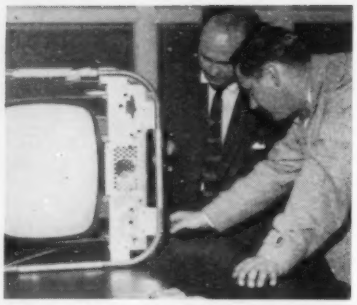
TV manufacturers sponsor course for service technicians

The first industry-sponsored television servicing night-school course in Canada for technical and vocational schools started at the Ryerson Institute of Technology in Toronto on October 15. It is sponsored by the television manufacturers through the Electronic Industries Association of Canada. For practising television service technicians, this advanced upgrading course will enable technicians to learn the latest servicing theories and techniques. Some of the workbench test equipment has been supplied by members of EIA. Technicians who pass the final examinations will be awarded an industry-recognized certificate of proficiency.

The course, of sixteen weeks' duration—two nights a week—will be extended to cities and towns across Canada next year through the formation of local industry advisory groups working in co-operation with local boards of education.



Two students from the first service course sponsored by tv manufacturers

Stereo broadcasting studied in Britain

The BBC, in collaboration with Electric and Musical Industries Ltd. are testing an EMI system for transmitting stereo sound over a single radio channel.

Basically EMI's Percival system involves separating the sound program from the directional information at the transmitting end. At the receiving end the directional signal, by operating on the program signal, produces the stereophonic effect through two speakers.

Only a very narrow band is required for the directional information, and the range of the transmitter is not appreciably reduced.

IRE membership has reached 68,000

The IRE now stands as the largest body of professional men in the world. Membership of 68,000 was recently registered and stands some 5,000 names ahead of the next largest professional body.

In order to maintain the administration of such a group the Headquarters IRE Office consists of a permanent staff of four senior positions, the Executive Secretary, Chief Accountant, the Technical Secretary and the Office Manager. In addition there are 109 women on Headquarters staff in New York.

The American Institute of Electrical Engineers held a successful Power Industry Computer Conference in Toronto last month. Among the interesting field trips for delegates were visits to the plants of Ferranti-Packard Electric Ltd. (left) and International Business Machines Company Ltd. (right)

COMING EVENTS

November

12-14 Conference on Electronic Techniques in Medicine and Biology. Minneapolis, Minn.

17-19 Society of Technical Writers and Editors 1958 Convention. Washington, D.C.

17-20 Conference on Magnetism and Magnetic Materials, Philadelphia, Pa.

20-22 Acoustical Society of America. Chicago, Ill.

28-Dec. 4 Electronic Computer Exhibition, London, England.

December

3-5 Second National Symposium on Global Communications. St. Petersburg, Fla.

3-5 Eastern Joint Computer Conference. Philadelphia, Pa.

February 1959

1-6 AIEE Winter General Meeting. Statler Hotel, New York.

March

2-6 Western Joint Computer Conference. San Francisco, Calif.

23-26 Radio Engineering Show and IRE National Convention. New York.

April

5-10 Fifth Nuclear Congress. Cleveland, Ohio.

May

6-8 1959 Electronic Components Conference. Philadelphia, Pa.

Transistor servo amplifier

Transistors are being used more widely as experience and new semiconductors are acquired. D. G. W. Mace and R. N. Blunt of Canadian Westinghouse Co. Ltd. will describe a 60-watt transistorized low frequency amplifier in the December issue.

Leonard Bertin, Science Editor for The Financial Post, has just returned from Europe where he attended the atomic energy conference in Geneva. He will report on the significant highlights next month.

This year marks the 20th anniversary of the development of the klystron. Associate editor Ian Dutton (and camera) visited the plant of Varian Associates of Canada Ltd. to see how these tubes are made. His picture story will be one of the December features.

Free service for our readers

Keep your reference shelf up to date this easy way. All advertisements, new products and literature in this issue have a key number. For more information .....

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- direct reading, high accuracy
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- highest performance, easiest to use
- no "pre-amp" needed with many transducers
- immediate delivery; see your rep

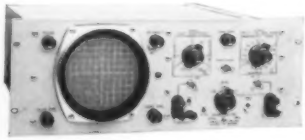
dc to 10 MC—$1,100

Models 150A/AR, world's premier hf oscilloscope. 24 direct reading sweep times; sweeps 0.02 μsec/cm to 15 sec/cm. Plug-in amplifiers for high gain, or dual channel use. 150A (cabinet) $1,100.00; 150AR (rack) $1,200.00.

dc to 300 KC—$650

Models 130A/BR, similar horiz. and vert. amplifiers, input circuits balanced 5 most sens. ranges. Single ended input ac or dc coupled. 1 μsec/cm to 12.5 sec/cm; 21 sweep times. 130BR includes x 5 magnifier. 130A (cabinet) or 130BR (rack) $650.00.

dc to 200 KC—$435



Models 120A/AR offer outstanding value, low price. Automatic trigger, 15 calibrated sweeps, sweep speed range 1 μsec/cm to 0.5 sec/cm, x 5 magnifier. Extra rugged, simple to use. 120A (cabinet) or 120AR (rack) $435.00.

Data subject to change without notice
Prices f.o.b. factory.

-*hp*- accessories extend oscilloscope performance

-*hp*- 152B Dual Trace Amplifier (for 150A/AR) provides differential input and dual traces electronically switched between A and B channels at either 100 KC or on alternate sweeps. $250.00.

-*hp*- 153A High Gain Amplifiers (for 150A/AR) permits 150A to be used for direct-from-transducer measurements without preamplification in many cases. Maximum sensitivity 1 mv/cm. $125.00.

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-*hp*- AC-21C 50:1 Voltage Divider Probe for 150A but usable with most other 'scopes, VTVM's, preamplifiers. 10 megohms input impedance; 2.5 μμf input capacitance. $25.00.

-*hp*- 115A Oscilloscope Cart. Designed for 150A, fits other 'scopes. Heavy chromed tube steel construction, lightweight. Scope shelf tilts 30° in 7½° increments. 4" rubber tired wheels, brakes. $80.00.

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L. D. Newman, Chief Inspector at Radio Communications Equipment and Engineering makes final checks on the new Department of Transport Type T 31/6 transmitter.

NEW DEPARTMENT OF TRANSPORT RADIO TRANSMITTER EQUIPPED WITH EIMAC TETRODES

The type T 31/6 radio transmitter, shown above, has just been designed and built for the Department of Transport by Radio Communications Equipment and Engineering, Montreal. It is equipped with six 4-1000A tetrodes, manufactured by Eitel-McCullough.

Designed for CW or radio-telephone operation, the transmitter has output of 1 kilowatt carrier, and a frequency coverage of from 2 to 30 megacycles. It consists of 6 radio frequency units complete with a common modulator and power supply. A separate radio frequency unit is used for each channel so as to provide instantaneous channel switching. Complete operational control, including channel selection, may be accomplished remotely up to a distance of 20 miles over a standard telephone pair.

The Eimac 4-1000A tetrodes in the final amplifiers (the large glass tubes at the left of each unit in the photograph) operate Class C, each giving one kilowatt output when keyed, and one kilowatt carrier when amplitude modulated.

The design, quality and performance of Eimac tubes have made them first choice by manufacturers in many different fields, and for a variety of different applications. Tetrodes, pentodes, triodes, klystrons—it pays to investigate Eimac, whatever your requirements.

For further information, or for specific recommendations, write our Canadian representative: R. D. B. Sheppard, 2036 Prince Charles Road, Ottawa 3.

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